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SELECTED WATER RESOURCES ABSTRACTS

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VOLUME 3, NUMBER 7
APRIL 1, 1970

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SELECTED
WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

LIBRARY U. S. DEPT. OF THE INTERIOR

VOLUME 3, NUMBER 7
APRIL 1, 1970

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Use of funds for printing this publication approved by the Director of the Bureau of the Budget, September 4, 1968.

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

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FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

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02 WATER CYCLE
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ABSTRACT SOURCES

SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

1A. Properties

PROTON MAGNETIC RESONANCE SPECTRUM OF POLYWATER,
Princeton Univ., N.J. Dept. of Chemistry.
Gregory A. Petsko.
Science, Vol 167, No 3915, p 171, Jan 9, 1970. 1 p, 1 fig, 4 ref.

Descriptors: *Water structure, *Water properties, *Water analysis, *Nuclear magnetic resonance, *Hydrogen bonding, Analytical techniques, Molecular structure.
Identifiers: Proton magnetic resonance, Polywater.

With the aid of a time-average computer, the proton magnetic resonance spectrum of anomalous water (polywater) is obtained. The spectrum consists of a single broad resonance shifted approximately 300 hertz downfield from the resonance of ordinary water. The spectrum observed may be due to a deshielding by the 'ring current' from the delocalized Pi electrons of the oxygen atoms of the sample, combined with a high degree of hydrogen bonding between molecules, although other explanations are possible. This is in agreement with hexagonal ring structure. (Knapp-USGS)
W70-02617

POLYWATER: PROTON NUCLEAR MAGNETIC RESONANCE SPECTRUM,
Battelle Memorial Inst., Columbus, Ohio; and Maryland Univ., College Park, Dept. of Chemstry.
Thomas F. Page, Jr., Robert J. Jakobsen, and Elis R. Lippincott.
Science, Vol 167, No 3914, p 51, Jan 1970. 1 p, 2 fig, 7 ref.

Descriptors: *Water structure, *Water properties, *Density, *Nuclear magnetic resonance, Spectroscopy, Infrared radiation, Optical properties, Hydrogen bonding, Molecular structure.
Identifiers: Water polymers, Polywater.

In the presence of water, the resonance of the strongly hydrogen-bonded protons characteristic of polywater appears at 5 parts per million lower applied magnetic field than water. Polywater made by a new method confirms the infrared spectrum reported originally. (Knapp-USGS)
W70-02618

SUPERDENSE WATER ICE,
Toledo Univ., Ohio. Ritter Astrophysical Center.
For primary bibliographic entry see Field 02C.
W70-02619

1B. Aqueous Solutions and Suspensions

THERMODYNAMIC MIXING PROPERTIES OF NaCl LIQUIDS,
Harvard Univ., Cambridge, Mass. Dept. of Geological Sciences.
For primary bibliographic entry see Field 02K.
W70-02627

SOLUBILITIES OF NITROGEN, OXYGEN, AND ARGON IN DISTILLED WATER,
Amherst Coll., Mass. Dept. of Physics.
For primary bibliographic entry see Field 02K.
W70-02701

SOLUBILITY OF ATMOSPHERIC OXYGEN IN WATER,
Harvard Univ., Cambridge, Mass. Sanitary Engineering Div.
For primary bibliographic entry see Field 02K.
W70-02702

NEW TABLES FOR OXYGEN SATURATION OF SEAWATER,
Carnegie Inst. of Tech., Pittsburgh, Pa.; and Massachusetts Inst. of Tech., Cambridge.
E. J. Green, and D. E. Carritt.
Journal of Marine Research, Vol 25, p 140-147, Feb 1967. 1 fig, 3 tab, 14 ref.

Descriptors: *Solubility, *Dissolved oxygen, *Seawater, *Temperature, Chlorides.
Identifiers: *Chlorinity, Green's equation, Saturated solubility of oxygen.

Currently available tables for the calculation of oxygen saturation values of seawater are discussed. New tables of the oxygen solubility (ml/l and ug-at/l), in seawater from a water-saturated atmosphere of which oxygen is 0.2094 mile fraction, excluding water vapor, have been prepared based on Green's equation by machine computation. The vapor pressure of seawater has been computed by combining the Goff-Gratch formulation for the vapor pressure of pure water with a relationship for the vapor pressure lowering by sea salt derived from the data of Arons and Kientzler. The vapor pressure so derived was combined with the Bunsen coefficient to calculate the saturated solubility of oxygen per liter of seawater as a function of temperature and chlorinity. A nomogram for oxygen solubi lity in seawater at equilibrium for laboratory use is added. The values determined for fresh water agree well with those of Klots and Benson and those of Montgomery, Thom, and Cockburn. (Rietveld-Vanderbilt)
W70-02704

DETERMINATION OF DISSOLVED OXYGEN BY THE WINKLER METHOD AND THE SOLUBILITY OF OXYGEN IN PURE WATER AND SEA WATER,
Water Pollution Research Lab., Stevenage (England).
For primary bibliographic entry see Field 02K.
W70-02705

NEW MEASUREMENTS OF OXYGEN SOLUBILITY IN PURE AND NATURAL WATER,
Johns Hopkins Univ., Baltimore, Md. Dept. of Oceanography.
For primary bibliographic entry see Field 02K.
W70-02712

02. WATER CYCLE

2A. General

THEORETICAL BASEFLOW CURVES,
Illinois State Water Survey, Urbana. Hydrology Section.
Krishan P. Singh.
ASCE Proc, J Hydraul Div, Vol 95, No HY6, Pap 6905, p 2029-2048, Nov 1969. 20 p, 9 fig, 3 tab, 10 ref, append.

Descriptors: *Base flow, *Surface-groundwater relationships, *Mathematical studies, Groundwater movement, Aquifers, Artesian wells, Streamflow, Evapotranspiration, Hydraulics, Leakage, Recharge.
Identifiers: Base flow curves.

Baseflow curves are obtained by solving a nonlinear partial differential equation of groundwater flow for different boundary conditions. A theoretical basis is provided for differentiating between these curves for shallow and deep aquifers. Various linearized solutions and their limitations and errors are elucidated. Mathematical expressions are derived for the effects of evapotranspiration and leakage loss in substantially reducing the baseflow and rendering the stream influent or dry. Upward leakage from an underlying artesian aquifer causes the baseflow to be more sustained and reduces its recession rate. Aquifer recharge of duration T, simulated by a sine function, leads to a baseflow hydrograph which peaks at 0.75 T and becomes parallel to the no-recharge curve after about 1.5 T. (Knapp-USGS)
W70-02460

INDIRECT EVALUATION OF SOME CHARACTERISTICS OF A HYDROLOGICAL REGIME OF RIVERS UNDER CONDITIONS OF EXCESSIVE MOISTURE (RUSSIAN),
A. M. Komlev.
In: Vodnye Resursy i Vodnoe Khozyaystvo Sibiri (Water Resources and Water Economy of Siberia), Akad Nauk SSSR, Sibirskoye Otdelenie, Geogr Obshchestvo, Novosibirsk, USSR, p 38-46, 1968. 9 p, 2 fig, 1 tab, 9 ref.

Descriptors: *Surface waters, *Hydrologic properties, *Rivers, Meteorology, Vegetation, Bogs, Lakes, Groundwater, Drainage, Forests, Topography, Runoff, River basins, Watersheds (Basins), Geology, Hydrogeology, Underground storage.
Identifiers: *USSR, Siberia, Excessive moisture regimes.

The hydrological characteristics of the Tyumen region of Western Siberia, characterized by excessive moisture and the presence of numerous lakes and bogs, were investigated by evaluating runoff and the distribution and areal extent of lakes, bogs, and forests. These hydrologic characteristics were then analyzed to determine their association, if any, with the coefficients of areal extent of lakes, bogs, and forests. Definite associations exist between these coefficients and the monthly runoffs. (Gabriel-USGS)
W70-02482

DESERTS; THE PROBLEM OF WATER IN ARID LANDS,
London Univ. (England). Inst. of Education
Martin Simons
London, Oxford University Press, 1967. 96 p, 40 fig, 46 plates

Descriptors: Arid lands, Water, Acclimatization, *Water transfer, Climatology, Desalination, Irrigated lands, Saturated soils, Saline soils, Groundwater, Surface waters, Deserts, Desalination processes, Nuclear power plants, Animal physiology, Plant physiology, Plant morphology, Water shortage, Economic efficiency, Arable land, California, Weather modification, Agriculture
Identifiers: *Western U.S., *USSR, Africa, Pakistan, India, Israel, Arabia

The author presents an extensive and well illustrated overview of the problems of arid lands throughout the world. Over a third of the world's land surface is desert or semidesert. The book begins with a brief review of climatic causes and types of arid and semiarid lands of the world. Discussions follow concerning arid lands plants and animals and their morphological and physiological adjustments to the environment. The major part of the book is devoted to discussions of all the possible sources of water known to man that might be used in developing arid lands. Included are explanations of groundwater occurrence and development in many parts of the world. Origins of rivers that flow through arid regions are illustrated with examples from North Africa, Pakistan, India, the Arab States, Israel, South Africa and western U.S. This section closes with a consideration of problems of waterlogging and salinization which occur when irrigation is not combined with adequate drainage. Treatment of water transfer from humid to arid lands is illustrated primarily with examples from California and central USSR. Various processes for desalination of sea water and brackish water and their present and potential applications are reviewed. The author finally raises the question of economic efficiency in committing water developments in arid lands to irrigation rather than to alternative uses such as industrial development. (Crouse-Arizona)
W70-02561

THE ROLE OF SOLID AND LIQUID PRECIPITATIONS IN RUNOFF FORMATION (RUSSIAN),
Akademiya Nauk Kazakhskoi SSR, Alma-Ata. Institut Gidrogeologii i Gidrofiziki.
For primary bibliographic entry see Field 02C.
W70-02654

DETERMINATION OF FLOWS FOR UNGAGED STREAMS,
Washington State Univ., Pullman.
Donald L. Bender.
Completion Report, Washington Water Research Center, Sept 1969. 9 p. OWRR Project A-009-WASH.

Descriptors: *Unit hydrograph, *Runoff simulation, *Laboratory watershed, Rainfall-runoff relationships, Catchments.
Identifiers: *Ungaged streams.

An 8-foot by 16-foot laboratory catchment was used as a hydrologic system to test certain relationships between rainfall and runoff. Unit hydrographs were obtained for a variety of catchment conditions and rainfall intensities and durations. A series of curves for each separate set of rainfall and catchment conditions for one-minute unit hydrographs illustrates that the peak of these unit hydrographs increases until the time of equilibrium is reached. After the time to equilibrium the peaks remain constant and for any given catchment condition the maximum peak discharges of the one-minute unit hydrographs are the same regardless of intensity. Also for a given catchment condition with the duration of rainfall greater than the time to equilibrium, the peak discharges of the total time duration unit hydrographs are the same regardless of intensity. Time to peak on the catchment is related linearly to the time to equilibrium. Kinematic wave formulation is used to express the equation of unsteady flow and a digital computer is used to numerically integrate them. Data from the laboratory catchment is used to verify equations.
W70-02748

GENERALIZED ANALYSIS OF SMALL WATERSHED RESPONSES,
California Univ., Davis.
J. Amorocho.
Available from the Clearinghouse as PB-188 908, $3.00 in paper copy, $0.65 in microfiche. Technical Completion Report WRC No 133, California Water Resources Center, Nov 1969. 5 p, 5 ref. OWRR Project B-005-CAL.

Descriptors: *Small watersheds, *Surface runoff, *Rainfall-runoff relationships, *Model studies, Storm-runoff, Streamflow, Flood prediction, Snowmelt, Demonstration watersheds, Small watersheds.

Several topics were investigated under the general heading 'Generalized Analysis of Small Watershed Responses.' Each topic resulted in a self-contained report, but jointly they contribute to a better understanding of various statistical and physical aspects of small watershed behavior: (1) The functional series representation for nonlinear physical system was used to develop a method permitting the determination of a nonlinear prediction equation and the nonlinear response functions for hydrologic systems. The method was tested successfully using rainfall and stream flow data of a small California watershed. (2) A method of curve fitting was applied to precipitation data of an array of rain gages in a small California watershed to obtain a functional representation of the time and space distribution of storm rainfall. This method may be used for the establishment of criteria for precipitation network design and for the analysis of watersheds as nonlinear systems with distributed input fields. (3) A simple cascade model of the rainfall-runoff process was developed to test whether the design of more complex mathematical models is justified from the standpoint of runoff prediction. (4) A detailed mathematical model of the physical processes producing snowmelt was developed. It is suitable for the prediction of net watershed imputs due to the fusion of snowfields, and may be incorporated into a comprehensive watershed model. (5) A study of the accuracy of the prediction of floods of high return period was conducted. It provided expressions for the standard errors of sample estimates of flood magnitudes corresponding to given return periods for normal and double exponential universes.
W70-02763

2B. Precipitation

SUITABILITY OF THE UPPER COLORADO RIVER BASIN FOR PRECIPITATION MANAGEMENT,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 03B.
W70-02622

FREQUENCY ANALYSIS OF RAINFALL INTENSITIES FOR CALCUTTA,
All-India Inst. of Hygiene and Public Health, Calcutta; and Calcutta Metropolitan Planning Organization (India).
V. Raman, and M. Bandyopadhya.
ASCE Proceedings, Journal of the Sanitary Engineering Divsion, Vol 95, No SA6, Paper 6950, p 1013-1030, Dec 1969. 18 p, 10 fig, 9 tab, 7 ref, append.

Descriptors: *Rainfall disposition, *Frequency analysis, *Duration curves, *Depth-area-duration analysis, Rainfall intensity, Probability, Statistical methods, Runoff, Rational formula, Rainfall-runoff relationships, Storm runoff, Storm drains, Drainage engineering.
Identifiers: *Calcutta (India).

Analysis of the point rainfall data in Calcutta, India for 23 yr yields a procedure for arriving at the relationship between the average intensity of excessive rainfall, the corresponding duration the rain continued to fall at the average rate, and the frequency with which these combinations of intensity and duration of such storms occur. Probability methods based on annual maximum events and partial duration series, and methematical and graphical curve fitting, based on frequency analysis, are employed for developing the relationships. Intensity duration frequency relations are expressed in tabular and graphical forms and as mathematical equations. The various methods do not give exactly identical results, and discretion must be used to choose between them for application in the design of a storm sewer system. No particular method can be considered as the best for rainfall frequency determination. (Knapp-USGS)
W70-02634

SOME EXPERIENCE IN EVALUATION OF ATMOSPHERIC PRECIPITATIONS IN THE MOUNTAINS OF TRANSILIAN ALA TAU (RUSSIAN),
Akademiya Nauk Kazakhskoi SSR, Alma-Ata. Institut Gidrogeologii i Gidrofiziki.
Ye. P. Mansurova, and I. S. Sosedov.
Gidrofizicheskie Issledovaniya v Gornykh Rajonakh Kazakhstana Akad Nauk Kazakhskoi SSR, Trudy Instituta Gidrogeologii i Gidrofiziki, Vol 2, p 3-18, 1969. 6 fig, 6 tab, 14 ref

Descriptors: *Precipitation (Atmospheric), *Mountains, Moisture content, Humidity, Winds, Instrumentation, Mathematical studies, Analytical techniques, Snow, Evaporation, Hydrologic data, Seasonal, Altitude.
Identifiers: *USSR, Transilian Ala Tau (Kazakh SSR).

The errors in measurements of atmospheric precipitation are analyzed. A method is given for interpolating corrected values of seasonal and annual precipitation. This interpolation is based on an empirically derived relationship between gaging station altitudes and atmospheric precipitation. (Gabriel-USGS)
W70-02650

RESULTS OF ATMOSPHERIC CIRCULATION STUDIES OVER EUROPE, ASIA, AND THE ARCTIC BY RADAR-METEOR TECHNIQUE (RUSSIAN),
Institute of Experimental Meteorology (USSR).
I. A. Lysenko, B. L. Kashcheyev, K. A. Karimov, M. K. Nazarenko, and A. D. Orlyansky.
English summary. Izvestiya Akademii Nauk, SSSR, Seriya Fiziki Atmosfery i Okeana, Vol 5, No 9, p 893-902, Sept 1969. 4 fig, 3 tab, 21 ref.

Descriptors: *Atmosphere, *Atmospheric pressure, *Air circulation, *Arctic, *Meteorites, Radar, Winds, Air masses, Anticyclones, Cyclones, Instrumentation, Measurement, Frequency analysis, Wavelengths, Model studies.
Identifiers: *USSR, Atmospheric circulation, Meteorological radar.

The results of synchronous measurements of the wind regime in the meteor zone are given on the basis of observations recorded from September 1965 to February 1966 in Kharkov, Obninsk, Kiev, Frunze Dushanbe, Tomsk, and on Hayes Island. On the basis of these data the cyclonic or anticyclonic character of prevailing air-mass motions in the meteor zone over Europe, Asia, and the Arctic is identified. (Gabriel-USGS)
W70-02655

ATTAINABLE ACCURACY OF LINEAR STATISTICAL FORECASTING AND OPTIMAL DIMENSIONS OF THE PREDICTOR (RUSSIAN),
A. S. Marchenko.
English summary. Investiya Akademii Nauk, SSSR, Seriya Fiziki Atmosfery i Okeana, Vol 5, No 9, p 883-892, Sept 1969. 1 tab, 7 ref.

Descriptors: *Forecasting, *Meteorology, *Statistical methods, *Hydrologic aspects, *Sampling, Hydrology, Mathematical studies, Analysis, Parametric hydrology, Equations, Atmosphere, Atmospheric pressure, Air temperature.
Identifiers: Forecasting statistics, Sampling statistics.

Forecast efficiency is investigated by means of the multiple regression equation taking into account the fact that a limited number of observations is used for evaluation of extrapolational parameters. The results are obtained on the assumption that the vector, composed of the predictor and predictant, is distributed normally and that extrapolational parameters are evaluated on the basis of the sampling of independent observations. The expected r.m.s. error is calculated theoretically from independent data, statistic hypotheses on its numerical value are formulated, and criteria for the test of the hypotheses are indicated. It is shown that there exists an optimal predictor dimension guaranteeing highest accuracy of extrapolation. (Gabriel-USGS)
W70-02656

LOCAL MOISTURE AND PRECIPITATION,
Nevada University, Reno. Center for Water Resources Research.
Charles K. Stidd.
Desert Research, Institute Preprint Series No 45, Nevada University, July 1968. 39 p, 5 fig, 26 ref, append. OWRR Proj B-008-Nev.

Descriptors: *Precipitation (Atmospheric), *Precipitable water, Evapotranspiration, *Meteorology, Water balance, Hydrologic budget, Climatology, Water resources development, Atmospheric physics, Air masses, Humidity, Hydrologic cycle, Weather.
Identifiers: Local moisture availability.

Evidence is presented to show that moisture evaporated or transpired from local soils and plants is important to the precipitation process. The evidence includes a seasonal water balance f or that portion of the world lying north of 30 deg N Latitude showing a reversal of the hydrologic cycle during the summer half-year, a discussion of annual cycles of precipitation in the United States showing the importance of local moisture to climate, a demonstration of the mechanism by which locally derived moisture can produce an unstable atmosphere leading to shower activity, and a statistically significant verification of an increase in summer rainfall associated with the Columbia Basin Irrigation Project. (Knapp-USGS)
W70-02668

2C. Snow, Ice, and Frost

GLACIAL DRAINAGE DIVIDE IN THE SKAGIT VALLEY, WASHINGTON,
Geological Survey, Spokane, Wash.
Paul L. Weis.
Geological Survey Research 1969, Professional Paper 650-C, p C71-C74, 1969. 4 p, 4 fig, 1 ref.

Descriptors: *Watersheds (Divides), *Pleistocene epoch, *Glaciation, *Geomorphology, *Washington, Drainage systems, Rivers, Interfluves, Glacial drift, Erosion.
Identifiers: Skagit Valley (Wash), Glacial drainage divide, Pleistocene drainage patterns.

Major valleys in the western part of the North Cascades primitive area have been intensely glaciated and characteristically have U-shaped cross sections, steep walls, flat floors, and relatively gentle gradients. A notable exception is the Skagit Valley, which has a segment about 7 miles long with a steep gradient and the V-shaped cross section characteristic of stream erosion. The valley upstream and downstream from the V-shaped gorge has the typical U-shaped cross section of a glaciated valley. This anomalous section of the Skagit Valley may best be explained by the hypothesis that it was a drainage divide during late Pleistocene time and was occupied by relatively stagnant ice. (Knapp-USGS)
W70-02458

OPEN-CHANNEL SURGE SIMULATION BY DIGITAL COMPUTER,
Georgia Inst. of Tech., Atlanta. School of Engineering, and Harza Engineering Co., Chicago, Ill. Dept. of Hydraulics.
For primary bibliographic entry see Field 08B.
W70-02459

RIVER ICE JAMS - A LITERATURE REVIEW,
United States Lake Survey, Detroit, Mich.
S. J. Bolsenga.
Corps Eng Lake Survey Res Rep 5-5, June 1968. 568 p, 35 fig, 430 ref.

Descriptors: *Ice jams, *Rivers, *Reviews, *Bibliographies, *Surveys, Water level flucuations, Floods, Melting, Frazil ice, Freezing, Slush, Ice, Ice breakup, Navigation, Flood control, Flood protection.
Identifiers: River ice jams, Ice floods.

About 400 published studies of river ice jams in many areas of the world were collected, examined, listed, and summarized. Both current and historical information on the ice jam mechanism and methods of prevention and removal are included. Descriptions of ice jam characteristics range from mathematical to narrative treatments. Methods of prevention and removal range from dusting and thermal pollution to the more widely used blasting. Trends in the use of these techniques are discussed. Lack of success in applying prevention and removal techniques is often caused by lack of basic information on ice jam characteristics. The results of this report can be useful in field operations, and a guideline for future research planning is provided. (Knapp-USGS)
W70-02494

SUPERDENSE WATER ICE,
Toledo Univ., Ohio. Ritter Astrophysical Center.
A. H. Delsemme, and A. Wenger.
Science, Vol 167, No 3914, p 44-45, Jan 1970. 2 p, 1 tab, 10 ref.

Descriptors: *Ice, *Water properties, *Water structure, Freezing, Density, Mechanical properties, Physical properties, Vapor pressure.
Identifiers: Amorphous ice.

A new allotropic form of water ice with a density of 2.32 plus or minus 0.15 grams per cubic centimeter has been observed at very low pressures and for temperatures lower than 100 deg K. It is most likely amorphous. Distilled water was outgassed, weighed, and conducted to an introduction chamber where it vaporized. The residual pressure of the water vapor in the main chamber was maintained at 0.0001 mm-Hg or less. The main chamber was then cut off from the vacuum pump and checked for leaks. Water vapor was introduced through a valve at a selected rate. During condensation, the pressure was maintained at 6 to 8 x 0.001 mm-Hg in the main chamber by controlling the rate of introduction of water vapor. At temperatures near or below 100 deg K, a new form of ice with very high density was produced. It does not seem that polywater, which solidifies at -40 deg C into a glasslike state, can be directly connected with our observations. (Knapp-USGS)
W70-02619

STALACTITE GROWTH BENEATH SEA ICE,
Naval Ship Engineering Center, Port Hueneme, Calif. Port Hueneme Div.
Russell A. Paige.
Science, Vol 167, No 3915, p 171-172, Jan 9, 1970. 2 p, 1 fig, 7 ref.

Descriptors: *Sea ice, *Brines, *Freezing, Water chemistry, Density, Density currents, Sea water.
Identifiers: Ice stalactites.

Fresh ice stalactites were observed beneath sea ice in Antarctica. They are hollow, tapering, inverted cones having a base diameter between 10 and 20 centimeters and a tip diameter of 4 to 10 cm extending downward about 100 cm. The stalactites form when dense, chilled brine drains downward from the ice sheet into seawater of normal salinity and near-freezing temperature. (Knapp-USGS)
W70-02620

A METHOD FOR THE DETERMINATION OF SNOW RESOURCES IN A MOUNTAIN BASIN (RUSSIAN),
Akademiya Nauk Kazakhskoi SSR, Alma-Ata. Institut Gidrogeologii i Gidrofiziki.
I. S. Sosevdov, and L. N. Filatova.
Gidrofizicheskie Issledovaniya v Gornykh Raionakh Kazakhstana Akad Nauk Kazakhskoi SSR, Trudy Instituta Gidrogeologii i Gidrofiziki, Vol 2, p 19-26, 1969. 4 fig, 2 tab, 8 ref.

Descriptors: *Snow, *Snowmelt, *Mountains, Mapping, Altitude, Slopes, Seasonal, River basins, Watersheds (Basins), Forests, Landslides.
Identifiers: *USSR, Alatau.

Water resources from snowmelt were investigated using a statistical method and observational data of snow thicknesses recorded in the Transilian Alatau. Snow water reserves can be predicted on the basis of snow thickness, altitude, and latitude parameters. (Gabriel-USGS)
W70-02649

SEASONAL FREEZING AND ITS HYDROLOGICAL EFFECT UNDER THE CONDITIONS OF THE NORTHERN SLOPE OF THE TRANSILIAN ALA TAU (RUSSIAN),
Akademiya Nauk Kazakhskoi SSR, Alma-Ata. Institut Gidrogeologii i Gidrofiziki.
V. A. Sazonov, and I. S. Sosedov.
Gidrofizicheskie Issledovaniya v Gornykh Raionakh Kazakhstana Akad Nauk Kazakhskoi SSR, Trudy Instituta Gidrogeologii i Gidrofiziki, Vol 2, p 94-100, 1969. 2 fig, 1 tab, 12 ref.

Descriptors: *Seasonal, *Freezing, *Soils, *Hydrologic properties, *Mountains, Ice, Soil water, Capillary action, Snow, Snow cover, Air temperature, Altitude, Vegetation, River basins.
Identifiers: *USSR, Transilian Ala Tau.

Seasonal regime of soil freezing, as a function of air temperature, altitude and geographical location, was investigated in the Transilian Ala Tau. Seasonal freezing of soil at altitudes of 3,000 to 3,200 m where the seasonal freezing is in contact with permafrost, strongly affects the formation of runoff, floods, and mud streams associated with the floods. The effects of air temperature and snow cover on the depth of freezing are given. (Gabriel-USGS)
W70-02653

THE ROLE OF SOLID AND LIQUID PRECIPITATIONS IN RUNOFF FORMATION (RUSSIAN),
Akademiya Nauk Kazakhskoi SSR, Alma-Ata. Institut Gidrogeologii i Gidrofiziki.
I. S. Sosedov.
Gidrofizicheskie Issledovaniya v Gornykh Raionakh Kazakhstana Akad Nauk Kazakhskoi SSR, Trudy Instituta Gidrogeologii i Gidrofiziki, Vol 2, p 101-109, 1969. 2 fig, 2 tab, 10 ref.

Descriptors: *Precipitation (Atmospheric), *Rain, *Snow, *Runoff, *Surface runoff, Erosion, Water supply, Water balance, Slopes, Seasonal, Mathematical studies, Soil water, Rain gages, Snow cover, Snowmelt, Altitude.
Identifiers: *USSR, Transilian Ala Tau.

Sources of surface runoff were investigated on the basis of a water balance equation in the Transilian Ala Tau region. Evaluation of the effects of altitude, snow cover, geographical location, vegetation, and slope orientation yields coefficients of runoff formed by solid (snow) and liquid (rain) precipitation. (Gabriel-USGS)
W70-02654

SCATTERING AND ATTENUATION OF RADIATION BY WATER-FILMED HAIL (RUSSIAN),
M. T. Abshayev, and V. I. Rozenberg.
Izvestiya Akademii Nauk, SSSR, Seriya Fiziki Atmosfery i Okeana, Vol 5, No 9, p 973-978, Sept 1969. 6 fig, 10 ref.

Descriptors: *Hail, *Atmosphere, *Radiation, *Attenuation, Clouds, Rain meteorological data, Meteorology, Ice, Mathematical models, Temperature, Water temperature, Films, Wavelengths, Radiosondes.
Identifiers: Radiation scattering.

Attenuation and scattering of radiation from hail was analytically investigated by assuming the temperature of the ice spheres and the water films to be 0 deg C. Several curves show the effect of ice sphere radius and water film thickness on the transversal cross-section of total attenuation and scattering. (Gabriel-USGS)
W70-02659

INVESTIGATION OF SOIL FREEZING,
Rhode Island Univ., Kingston. Dept. of Civil Engineering.
For primary bibliographic entry see Field 08E.
W70-02750

2D. Evaporation and Transpiration

WATER REQUIREMENTS OF LAWNGRASS,
Nevada Agricultural Experiment Station, Reno, and Agricultural Research Service, Amex, Iowa. Soil and Water Conservation Research Div
Rhys Tovey, John S. Spencer, and Dean C. Muckel.
American Society of Agricultural Engineers, Transactions, Vol 12, No 3, p 356-358, 1969. 4 tab, 2 fig, 8 ref.

Descriptors: *Arid lands, *Lawns, *Water requirements, *Irrigation efficiency, *Evapotranspiration, Semiarid climates, Nevada, Irrigation design, Lysimeters, Evaporation pans, Solar radiation, Estimating equations, Heat budget, Soil moisture, Root zone, Soil-water-plant relationships, Soil moisture meters, Water conservation, Water management (Applied).

Knowledge of lawngrass water requirements is valuable since substantial amounts of water are often used in irrigation in arid and semiarid climates. Measured or estimated evapotranspiration is basic to irrigation system design and proper scheduling of irrigation. The authors report experiments performed near Reno, Nevada, to determine water requirements of lawngrass. The studies were conducted on lysimeters using a mixture of Kentucky Bluegrass, fescues and white clover. Water applied at each irrigation and effluent pumped from the lysimeters were measured. Soil moisture conditions were monitored, evaporation and net radiation measured and evapotranspiration calculated. Data and visual observations from studies continued over three seasons showed that twice weekly irrigations on sandy loam soil and weekly irrigations on loam soil maintained lawngrass with good appearance and healthy root development during the hot part of the growing season. Significant relationships were found between evapotranspiration estimates by the Penman and Olivier methods and measured evapotranspiration from lawngrass. The authors suggest that Blaney-Criddle coefficients may be useful in estimating irrigation requirements for lawngrass in other areas. (Crouse-Arizona)
W70-02562

TOTAL SUMMER EVAPORATION IN THE CENTRAL MOUNTAIN BELT OF TRANSILIAN ALATAU AND THE EFFECT OF SLOPE EXPOSURE ON EVAPORATION (RUSSIAN),
Akademiya Nauk Kazakhskoi SSR, Alma-Ata. Institut Gidrogeologii i Gidrofiziki.
I. S. Sosedov, and L. N. Filatova.
Gidrofizicheskie Issledovaniya v Gornykh Raionakh Kazakhstana Akad Nauk Kazakhskoi SSR, Trudy Instituta Gidrogeologii i Gidrofiziki, Vol 2, p 67-80, 1969. 5 fig, 5 tab, 6 ref.

Descriptors: *Evaporation, *Seasonal, *Mountains, *Slopes, Humidity, Infiltration, Soils, Soil physical properties, Fissures (Geology), Runoff, Instrumentation, Sprinkling, Filtration, Altitude, Vegetation, Water balance.
Identifiers: *USSR, Transilian Alatau, Summer evaporation.

Evaporation data recorded in the mountain belt of Transilian Alatau during snow-free and warm periods are analyzed on the basis of soil variation, altitude, vegetation cover, air temperature, and some hydrometeorological parameters. The study suggests the use of a logarithmic formula for the evaluation of the total monthly evaporation. Some relationship is present between the evaporation intensities and air temperatures. (Gabriel-USGS)
W70-02651

THE EFFECT OF THE ADDITION OF HEAT FROM A POWERPLANT ON THE THERMAL STRUCTURE AND EVAPORATION OF LAKE COLORADO CITY, TEXAS,
Geological Survey, Washington, D.C. Water Resources Div
G. E. Harbeck, Jr., G. E. Koberg, and G. H. Hughes.
Studies of Evaporation, Geological Survey Professional Paper 272-B, Washington, 1959. 49 p, 11 tab, 21 fig, 16 ref.

Descriptors: *Evaporation, *Lakes, *Heat balance, Thermal powerplants, Cooling, Energy budget, Heat budget, Reservoirs, Temperature, Solar radiation, Mass transfer, Circulation, Water utilization, Climatology, Humidity, Weather data, Vapor pressure, Thermal properties.

Lake Colorado City is used as a source of cooling water for a thermal-electric-powerplant. Evaporation from the lake was determined by the energy-budget method for the period July 1954 to October 1955. Analyses indicate that if no heat had been added by the powerplant, the water-surface temperature would have been only 0.8 deg C lower than that observed. The temperature rise is almost directly proportional to the heat input. The increase in evaporation from Lake Colorado City, when expressed as a volume, is directly proportional to the amount of heat added and is practically independent of reservoir content. The entire lake is being effectively utilized in disposing of heat. Water temperatures in the lower basin of the lake were higher in winter than those in the upper basin of the lake; no appreciable differences were observed in summer. Density differences between the two parts of the lake were very small at all times. A comparison between average lake temperatures and plant intake water temperatures indicates that water is withdrawn from all levels of the lake above the pump intakes. The average withdrawal temperature to be expected, if the amount of heat added by the powerplant is increased, probably will be about equal to the anticipated surface temperature, which can be determined from graphs in the text. (Novotny-Vanderbilt)
W70-02703

MEASUREMENT OF EVAPOTRANSPIRATION IN LOWLAND VEGETATION,
Mayard E. Bates, and Murray F. Buell.
New Jersey Academy of Science, The Bulletin, Vol 14, No 1-2, Spring-Fall 1969, Jan 2, 1970. 12 p. OWRR Project B-006-NJ.

Descriptors: *Evapotranspiration, *Swamp, Evaporation, Phreatophyte, Shrubs, Transpiration.
Identifiers: *Pine Forest, *Lowland vegetation, Evapotranspirometer.

Instrumentation is described whereby the evapotranspiration from bog vegetation can be measured under natural conditions. The instrumentation is automatic, measuring the input and output of water of a system necessary to maintain the same water table within as that prevailing outside the system. The system consists of a six foot square tank containing a unit of vegetation sunk into a bog of the same vegetation and monitored by a pumping and measuring station. The latter is connected through an underground pipe to an irrigation system in the bottom of the tank. The specific environment in the New Jersey Pine Barrens for which it is designed is described. The questions concerned with the Pine Barrens vegetation under relations which it is expected to answer are discussed.
W70-02733

2E. Streamflow and Runoff

TRIANGULAR BROAD-CRESTED WEIR,
Saskatchewan Univ., Saskatoon. Dept. of Civil Engineering; and Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 07B.
W70-02449

DATA ERROR EFFECTS IN UNIT HYDROGRAPH DERIVATION,
New South Wales Univ., Sydney (Australia). Dept. of Civil Engineering, and Imperial Coll. of Science and Technology, London (England).
For primary bibliographic entry see Field 07A.
W70-02454

FLUCTUATING PRESSURES IN SPILLWAY STILLING BASINS,
Minnesota Univ., Minneapolis. Dept. of Civil Engineering; and Iowa State Univ., Ames. Dept. of Engineering Mechanics
For primary bibliographic entry see Field 08B.
W70-02457

URBAN RUNOFF BY ROAD RESEARCH LABORATORY METHOD,
Illinois State Water Survey, Urbana.
For primary bibliographic entry see Field 04C.
W70-02467

AN INVESTIGATION OF FLOODS IN HAWAII THROUGH SEPTEMBER 30, 1968,
Geological Survey, Honolulu, Hawaii.
For primary bibliographic entry see Field 07C.
W70-02471

FLOW BELOW DEEPLY SUBMERGED RECTANGULAR WEIRS,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
N. Rajaratnam, and D. Muralidhar.
J Hydraul Res, Vol 7, No 3, p 355-374, 1969. 20 p, 13 fig, 2 tab, 8 ref.

Descriptors: *Open channel flow, *Weirs, Discharge (Water), Supercritical flow, Critical flow, Turbulent flow, Vortices, Turbulence, Jets
Identifiers: *Submerged flow, *Submerged weirs.

Flow over weirs submerged more than 90% was studied in a laboratory flume. The vena contracta occurs at a distance of about 1.0 t from the weir where t is the tailwater depth above the crest and the coefficient of contraction is about 0.74. Beyond the vena contracta, there is a flow development region of length equal to about 2 t. Beyond the end of the potential core, the fully developed flow region has been found to be essentially the same as a half turbulent free jet, with some difference in the growth of the length scale. The length of the eddying region or standing eddy was studied using dimensional analysis and the experimental results. A simple discharge equation was developed to predict the discharge over submerged rectangular weirs when the submergence ratio is greater than about 90%. (Knapp-USGS)
W70-02472

SCALING PROCEDURES FOR MOBILE BED HYDRAULIC MODELS IN TERMS OF SIMILITUDE THEORY,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 02J.
W70-02473

AIR ENTRAINMENT BY FLOWING WATER UNDER REDUCED ATMOSPHERIC PRESSURE,
Engineering Labs., Cambridge (England).
A. M. Binnie, and G. P. Sims.
J Hydraul Res, Vol 7, No 3, p 279-299, 1969. 21 p, 10 fig, 16 ref.

Descriptors: *Closed conduit flow, *Air entrainment, *Hydraulic models, Model studies, Aeration, Bubbles, Cavitation, Spillways, Siphons, Pipelines, Water conveyance.
Identifiers: Reduced air pressure.

A circular water tank, with a vertical pipe as overflow, and a small siphon-spillway drawing from a

reservoir were placed in turn in a decompression chamber. At ambient pressures down to 2 inches Hg absolute, measurements were made of the water and air discharges at various supply levels. The reduction of ambient pressure had two consequences: (1) the air flow was also reduced; (2) the onset of cavitation in the vertical-pipe apparatus was facilitated. In the siphon, cavitation did not occur. In both sets of apparatus the reduction of ambient pressure H had no noticeable effect on the relation between the head and the water discharge, although the air discharge was lessened. (Knapp-USGS)
W70-02474

FLOODS OF JUNE 1, 1967 IN SOUTHWESTERN JACKSON, MISSISSIPPI,
Geological Survey, Jackson, Miss. Water Resources Div.
Kenneth V. Wilson.
Geological Survey Open-file Report, Sept 1968.

Descriptors: *Floods, *Mississippi, *Rainfall intensity, *Urbanization, Discharge (Water), Stage-discharge relations, Hydrographs, Profiles, Mapping, Hydrologic data, Data collections.
Identifiers: Jackson (Miss).

An intense rainfall of 2 to 4 inches on June 1, 1967, most of it falling within 1 hour, caused unusual flooding in southwestern Jackson, Mississippi. The frequency of this rainfall at the U.S. Corps of Engineers Waterways Experiment Station near Clinton exceeded 25 years for periods less than 1 1/2 hours. The frequency flooding of Hardy Creek was greater than 50 years at McDowell Road and dissipated to about 10 years at Terry Road. The frequency of flooding of Cany Creek exceeded once in 50 years at Raymond Road but was only a 10-year flood at Cooper and Terry Roads. Baker Creek, which drains from the extreme western part of Jackson, flooded Spring Ridge Road to considerable depths. The frequency of this flood on Baker Creek was about 17 years. (Knapp-USGS)
W70-02477

INDIRECT EVALUATION OF SOME CHARACTERISTICS OF A HYDROLOGICAL REGIME OF RIVERS UNDER CONDITIONS OF EXCESSIVE MOISTURE (RUSSIAN),
For primary bibliographic entry see Field 02A.
W70-02482

FLOODS IN TRIPLETT CREEK IN VICINITY OF MOREHEAD, KENTUCKY,
Geological Survey, Washington, D.C.
C. H. Hannum.
Geol Surv Hydrologic Investigations Atlas HA-342, 1 sheet, 1969. Text, 7 fig, 1 map, 2 photo, 3 ref.

Descriptors: *Floods, *Kentucky, *Data collections, *Hydrologic data, Mapping, Streamflow, Stage-discharge relations, Flood damage, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: *Morehead (Ky), Triplett Creek.

Hydrologic data that can be used to evaluate the extent, depth, and frequency of floods of Triplett Creek, Morehead, Kentucky are presented in a 1-sheet hydrological atlas consisting of a map, photographs, profiles, cross sections, graphs, and text. The data are a technical basis for solving flood plain problems and formulating land use regulations to reduce future damages. Areas that would be flooded by 5-, 25, and 50-year floods are shown on a 1:12,000 topographic map. Past floods and recurrence intervals are plotted on graphs. Cross sections and profiles show flood depths at selected locations. (Knapp-USGS)
W70-02496

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, LOGTOWN QUADRANGLE, MISSISSIPPI,
Geological Survey, Washington, D.C.
K. V. Wilson, and James W. Hudson.
Geol Surv Hydrol Invest Atlas HA-395, 1 sheet, 1969. Text, 2 fig, 1 map, 1 tab, 3 ref.

Descriptors: *Floods, *Mississippi, *Hurricanes, *Flood damage, *Coasts, Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Winds, Disasters, Storms, Waves (Water), Water levels, Water level fluctuations, Inlets (Waterways), Sea level, Shores.
Identifiers: *Hurricane Camille (1969), Logtown (Miss), Tidal floods, Storm tides.

The areas flooded by Hurricane Camille tides of August 18, 1969 along the Mississippi Gulf Coast are shown in a series of hydrologic atlases. The Atlas of the Logtown quadrangle shows flooded areas on a topographic map scaled 1:24,000. Camille was the most intense hurricane on record to enter the U. S. mainland. Estimated maximum winds were 190 mph, and the central pressure was 26.61 inches of mercury. The eye of the storm, traveling about due north, passed over the Waveland-Bay St. Louis area and winds of over 75 mph extended about 50 mi on each side. Maximum precipitation was 10 inches. Flooding was most severe in the Pass Christian area where tides reached 25 ft above msl. High tide frequency and annual maximum tide are shown by graphs. (Knapp-USGS)
W70-02497

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, ENGLISH LOOKOUT QUADRANGLE, LOUISIANA-MISSISSIPPI,
Geological Survey, Washington, D.C.
K. V. Wilson, and James W. Hudson.
Geol Surv Hydrol Invest Atlas HA-396, 1 sheet, 1969. Text, 2 fig, 1 map, 1 tab, 3 ref.

Descriptors: *Floods, *Mississippi, *Hurricanes, *Flood damage, *Coasts, Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Winds, Disasters, Storms, Waves (Water), Water levels, Water level fluctuations, Inlets (Waterways), Sea level, Shores.
Identifiers: *Hurricane Camille (1969), English Lookout (Miss), Tidal floods, Storm tides.

The areas flooded by Hurricane Camille tides of August 18, 1969 along the Mississippi Gulf Coast are shown in a series of hydrologic atlases. The Atlas of the English Lookout quadrangle shows flooded areas on a topographic map scaled 1:24,000. Camille was the most intense hurricane on record to enter the U.S. mainland. Estimated maximum winds were 190 mph, and the central pressure was 26.61 inches of mercury. The eye of the storm, traveling about due north, passed over the Waveland-Bay St. Louis area and winds of over 75 mph extended about 50 mi on each side. Maximum precipitation was 10 inches. Flooding was most servere in the Pass Christian area where tides reached 25 ft above msl. High tide frequency and annual maximum tide are shown by graphs. (Knapp-USGS)
W70-02498

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, KILN QUADRANGLE, MISSISSIPPI,
Geological Survey, Washington, D.C.
K. V. Wilson, and James W. Hudson.
Geol Surv Hydrol Invest Atlas HA-397, 1 sheet, 1969. Text, 2 fig, 1 map, 1 tab, 3 ref.

Descriptors: *Floods, *Mississippi, *Hurricanes, *Flood damage, *Coasts, Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Winds, Disasters, Storms, Waves (Water), Water levels, Water level fluctuations, Inlets (Waterways), Sea level, Shores.
Identifiers: *Hurricane Camille (1969), Kiln (Miss), Tidal floods, Storm tides.

The areas flooded by Hurricane Camille tides of August 18, 1969 along the Mississippi Gulf Coast are shown in a series of hydrologic atlases. The Atlas of the Kiln quadrangle shows flooded areas on a topographic map scaled 1:24,000. Camille was the most intense hurricane on record to enter the U.S. mainland. Estimated maximum winds were 190 mph, and the central pressure was 26.61 inches of mercury. The eye of the storm, traveling about due north, passed over the Waveland-Bay St. Louis area and winds of over 75 mph extended about 50 mi on each side. Maximum precipitation was 10 inches. Flooding was most severe in the Pass Christian area where tides reached 25 ft above msl. High tide frequency and annual maximum tide are shown by graphs. (Knapp-USGS)
W70-02499

FLOODS IN MISSISSIPPI-SEPTEMBER 1965 THROUGH SEPTEMBER 1967,
Geological Survey, Jackson, Miss.
B. E. Wasson.
Mississippi State Board of Water Commissioners Bulletin 69-1, June 1969. 31 p, 8 fig, 1 tab, 3 ref.

Descriptors: *Floods, *Mississippi, *Streamflow, *Rainfall, Rainfall-runoff relationships, Hydrologic data, Data collections, Storms, Hurricanes, Rain, Tides, Waves (Water), Winds.
Identifiers: Mississippi floods (1965-1967).

Several locally severe floods occurred in Mississippi in the period September 1965-September 1967. On September 10, 1965, a tidal wave caused by Hurricane Betsy was responsible for much damage along the western half of the Mississippi gulf coast. Extreme floods occurred February 10, 1966, on streams draining between 10 and 200 sq mi in a relatively narrow area of heavy rainfall between Vicksbury and New Albany. General but less severe flooding occurred in the central and southern parts of the State between February 9-17. During the last half of April 1966 two storm periods caused heavy rain in central Mississippi and unusual floods in the southwestern part of the State. The floods of April 13-15, 1967, in southwestern Mississippi were unusual but not as high as the floods of October 4, 1964. On June 1, 1967, a cloudburst rain caused 50-yr or greater floods on small-drainage areas in southwestern Jackson. Another small-area rain caused 50-yr or greater floods on small streams near Hickory Flat on July 9, 1967. Rainfall as great as 13 inches in 24 hr along the Mississippi gulf coast on September 6, 1967, caused no record floods. (Knapp-USGS)
W70-02621

FLOOD PLAIN INFORMATION OF SCAUAQUADA CREEK, IN THE TOWNS OF CHEEKTOWAGA AND LANCASTER, ERIE COUNTY, NEW YORK.
Corps of Engineers, Buffalo, N.Y.
For primary bibliographic entry see Field 04A.
W70-02629

CALCULATION OF SLOPE STABILITY OF RIVERS AND DRAINAGE CANALS (RUSSIAN),
A. F. Pechkurov.
Gidrotekhnika i Melioratsiya, No 9, p 61-73, Sept 1969. 7 fig, 4 tab.

Descriptors: *Slope stability, *Slopes, Rivers, Drainage, Canals, River beds, Bogs, Marshes, Mathematical studies, Gravity, Seepage, Friction, Climates, Freezing, Geology, Porosity, Peat, Runoff, Hydraulic properties, Floods, Erosion.
Identifiers: *USSR, Canal bank stability.

Slope stability calculations are based on the ultimate equilibrium of soil surfaces, the behavior of groundwater and streamflow, the structural and molecular cohesion of earth particles under water, and friction. Several slope stability observations were recorded on many rivers and streams of the USSR under various conditions of slope soil moisture and composition. The applicability of porous concrete plates of various thicknesses is demonstrated for improvement of slope stability of rivers and drainage canals. (Gabriel-USGS)

W70-02658

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, KREOLE-GRAND BAY SW QUADRANGLES, MISSISSIPPI-ALABAMA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-02660

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, BAY ST. LOUIS QUADRANGLE, MISSISSIPPI,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-02661

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, GULFPORT NW QUADRANGLE, MISSISSIPPI,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-02662

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, PASS CHRISTIAN QUADRANGLE, MISSISSIPPI,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-02663

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, GULFPORT NORTH-SOUTH QUADRANGLES, MISSISSIPPI,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-02664

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, VIDALIA QUADRANGLE, MISSISSIPPI,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-02665

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, WAVELAND-GRAND ISLAND PASS QUADRANGLES, MISSISSIPPI,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-02666

FLOOD PLAIN INFORMATION OF CANANDAIGUA OUTLET IN THE COUNTIES OF ONTARIO AND WAYNE, NEW YORK.
Corps of Engineers, Buffalo, N.Y.
For primary bibliographic entry see Field 04A.
W70-02667

BIG BLACK RIVER, MISSISSIPPI COMPREHENSIVE BASIN STUDY - ANNEX F. GEOLOGY AND WATER RESOURCES,
Geological Survey, Jackson, Miss. Water Resources Div.
B. E. Wasson
Big Black River Basin Coordinating Committee Rep, Vol 4, Annex F, Apr 1968. 43 p, 13 fig, 4 tab, 33 ref

Descriptors: *Water resources, *Surface waters, *Groundwater, *Mississippi, Streamflow, Aquifers, Water quality, Water yield, Water wells, Hydrologic data, Data collections, Water resources development
Identifiers: *Big Black River (Miss)

Abundant supplies of water of good quality are available in the Big Black River basin, Mississippi, from either groundwater or surface water sources. For 90% of the time flow in the lower part of the Big Black River below Pickens is not less than 85 cfs. Chemical quality of water in the streams is excellent, except for impairment caused by pollution at several places. Most of the available groundwater is contained in 6 geologic units from 100 to 1,000 ft thick. The aquifers overlap to the extent that a well drilled to the base of fresh water will in most places penetrate two or more aquifers. Well depths range from less than 10 to 2,400 ft. Water suitable for most needs can be obtained from the aquifers available at most localities. Shallow groundwater (less than 200 ft deep) in the basin usually contains about 100 ppm of dissolved solids. Most water in the basin from more than 2,500 ft below land surface contains more than 1,000 ppm of dissolved solids. Practically all water used in the basin is from the ground (about 11 mgd); however, a small amount of surface water is used for supplemental irrigation of row crops. Most of the area is underlain by one or more aquifers from which a properly constructed well could produce as much as 2,000 gpm. All the towns in the area have sufficient g roundwater available to at least double or triple their groundwater pumpage. (Knapp-USGS)
W70-02672

JETS WITH NEGATIVE BUOYANCY IN HOMOGENEOUS FLUID,
Waterloopkundig Laboratorium, Delft (Netherlands).
Gerrit Abraham.
Journal of Hydraulics Research, Vol 5, No 4, p 235-248, 1967. 1 tab, 3 fig, 9 ref.

Descriptors: *Jets, *Buoyancy.
Identifiers: *Entrainment, Flow pattern.

This study analyzes the flow pattern of a jet issuing vertically upwards into a lighter homogeneous ambient fluid and the decrease of the vertical flux of tracer near the ceiling level is taken into consideration to determine the coordinate of the ceiling level. Only three-dimensional axisymmetrical jets are considered. The author analyzes two zones: (a) zone with positive entrainment, near the orifice and (b) zone with negative entrainment, near the ceiling level, and gives mathematical solutions for both cases. A comparison between previously published theories and experimental data was made. The position of the ceiling level fluctuates with time when making a comparison between the present theory and previously published theories. Also, the present theory gives higher values of the coordinate of ceiling level than found by Morton and by Priestley and Ball. The experiments confirm that the present theory gives the ceiling level when it is high and that the solution of Morton gives the ceiling level when it is low; but both theories are of equal practical significance. The theory of Priestley and Ball gives the ceiling level when it is high, contrary to expectations. (Guerrero-Vanderbilt)
W70-02715

CURRENT STUDY IN THE NEUSE RIVER AND ESTUARY OF NORTH CAROLINA,
North Carolina Univ., Morehead City. Inst of Marine Sciences.
For primary bibliographic entry see Field 02L.
W70-02760

GENERALIZED ANALYSIS OF SMALL WATERSHED RESPONSES,
California Univ., Davis.
For primary bibliographic entry see Field 02A.
W70-02763

2F. Groundwater

FUTURE OF GROUND WATER IN AFRICAN SAHARA DESERT,
Alexandria Univ. (Egypt). Faculty of Engineering.
H. Y. Hammad.
ASCE Proc, J Irrig and Drainage Div, Vol 95, No IR4, Pap 6986, p 563-580, Dec 1969. 18 p, 7 fig, 7 tab, 11 ref, append.

Descriptors: *Water resources development, *Arid lands, Water wells, Pumping, Recharge, Mathematical studies, Water supply, Discharge (Water), Water storage, Irrigation, Irrigation water, Aquifers.
Identifiers: Sahara Desert, Oases.

The two-dimensional problem of unsteady seepage flow through a confined sand bed of vast plan area is attempted on mathematical lines. The treatment is applied to the groundwater reservoir lying under the vast African Sahara Desert with the object of determining the amount of recharge to this aquifer as well as the amount of its storage. The future groundwater discharges of two main oases in Egypt (namely Kharga and Dakhla) have been predicted to the year 2000. The free flow discharge of Kharga Oasis at present can irrigate a cultivated area of about 10,000 acres, the corresponding area of Dakhla Oasis being 22,000 acres. The installation of pumps in Kharga wells increases their discharge by about 15% and those of Dakhla by about 7%. Owing to various complications in the pump installation, and the low water gain obtained by them, pumps should not be used. Their expenses far exceed the water gain. (Knapp-USGS)
W70-02452

NONLINEAR FLOW IN POROUS MEDIA BY FINITE ELEMENTS,
Townsville Univ. Coll. (Australia). Dept. of Civil Engineering.
Raymond E. Volker.
ASCE Proc, J Hydraul Div, Vol 95, No HY6, Pap 6927, p 2093-2114, Nov 1969. 22 p, 6 fig, 3 tab, 35 ref, append.

Descriptors: *Groundwater movement, *Mathematical models, Hydraulic models, Piezometry, Dupuit-Forchheimer theory, Numerical analysis, Porous media, Discharge (Water), Equations.
Identifiers: Nonlinear groundwater flow.

Two commonly suggested forms of the equations linking head loss and velocity for flow of water through coarse granular media are the Forchheimer and exponential relations. Combined with the continuity expression, these relations give the differential equations applicable, within the limits of validity of the parent relations, to actual regions of flow. The resultant nonlinear partial differential equations are amenable to solution by the numerical technique known as the method of finite elements. This technique has advantages when dealing with complex boundary shapes. Solutions have been obtained for some examples of unconfined flow with boundary conditions similar to those likely to be encountered in practical applications. Experimental work in an open flume has shown that agreement between observed and calculated values of discharge and piezometric head can be obtained when the coefficients in the head loss equations are accurately known. (Knapp-USGS)
W70-02455

THEORETICAL BASEFLOW CURVES,
Illinois State Water Survey, Urbana. Hydrology Section.
For primary bibliographic entry see Field 02A.
W70-02460

NONLINEAR FLOW IN POROUS MEDIA,
Missouri Univ., Rolla. Dept. of Civil Engineering; and Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
Nazeer Ahmed, and Daniel K. Sunada.
ASCE Proc, J Hydraul Div, Vol 95, No HY6, Pap 6883, p 1847-1857, Nov 1969. 11 p, 2 fig, 1 tab, 19 ref, append.

Descriptors: *Saturated flow, *Porous media, *Filtration, *Dimensional analysis, *Groundwater movement, DupuitiForchheimer theory, Hydraulics, Turbulence, Convection, Mathematical studies, Reviews.
Identifiers: *Nonlinear flow (Porous media).

Many investigators are concerned about the validity of the Forchheimer equation which represents the relationship between the velocity of flow and pressure gradient in porous media. A theoretical development of this equation through analysis of the dimensionless form of the Navier-Stokes equation is presented. It shows that energy losses at high-flow velocities in porous medium are a result of convective acceleration effects, not turbulent effects. In addition, two dimensionless terms representing the flow behavior are defined and evaluated. It is shown that a constant could be used to represent the geometric properties of the medium and that a characteristic length representative of the flow exists. Both of these quantities are easily evaluated through hydraulic measurements of gradients and flow velocities. Experimental data from many sources were used to evaluate the theoretical results. (Knapp-USGS)
W70-02464

THE INTERPRETATION OF INTERFERENCE TESTS IN NATURALLY FRACTURED RESERVOIRS WITH UNIFORM FRACTURE DISTRIBUTION,
Atlantic Richfield Co., Dallas, Tex.
For primary bibliographic entry see Field 08B.
W70-02469

AN INVESTIGATION OF THE FLOW REGIME FOR HELE-SHAW FLOW,
Shell Development Co., Houston, Tex.; and Purdue Univ., Lafayette, Ind.
For primary bibliographic entry see Field 08B.
W70-02470

UNDERGROUND WATER DEVELOPMENT.
For primary bibliographic entry see Field 06E.
W70-02530

WATER IN THE KAHUKU AREA, OAHU, HAWAII,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 03B.
W70-02623

BASIN TRACER CURVES INTERPRETED BY BASIC ANALYTICS,
Bason and Filter Specialty Co., Shreveport, La.
For primary bibliographic entry see Field 07B.
W70-02633

MEASURING SUBSURFACE SPRING FLOW WITH RADIOTRACERS,
Federal Water Pollution Control Administration, Dallas, Tex.; and Corps of Engineers, Tulsa, Okla. Engineering Div.
For primary bibliographic entry see Field 07B.
W70-02637

FREE WATER FLOW TO ROWS OF WELLS (RUSSIAN),
Cairo Univ. (Egypt).
M. Amer Abdel-Vakhab.
Gidrotekhnika i Melioratsiya, No 9, p 108-115, Sept 1969. 7 fig, 2 tab, 5 ref.

Descriptors: *Groundwater movement, *Water holes, *Water wells, *Mathematical studies, Irrigation wells, Irrigation, Water storage, Hydrogeology, Discharge (Water), Hydraulic models, Piezometry, Hydrodynamics, Water level fluctuations.
Identifiers: *USSR.

Hydrodynamic movement nets of groundwater flow to water wells were analytically investigated and the results were compared with available experimental data. Use of various published formulas give similar results which are comparable with results obtained by the use of experimental data. Variations of gradients, even of considerable magnitudes, do not effect the discharge values of water wells. It is of interest to note that experimental studies using flumes give a correct picture of groundwater movements toward water wells. (Gabriel-USGS)
W70-02657

BIG BLACK RIVER, MISSISSIPPI COMPREHENSIVE BASIN STUDY - ANNEX F. GEOLOGY AND WATER RESOURCES,
Geological Survey, Jackson, Miss. Water Resources Div.
For primary bibliographic entry see Field 02E.
W70-02672

GEOLOGY AND GROUNDWATER RESOURCES OF CASS COUNTY, NORTH DAKOTA: PART 3,
Geological Survey, Bismark, N. Dak.
Robert L. Klausing.
North Dakota Geological Survey Bull 47 and State Water Commission County Ground Water Studies 8, 1968. 77 p, 24 fig, 2 plate, 2 tab, 29 ref, append.

Descriptors: *Water resources, *Groundwater, *North Dakota, Water wells, Aquifers, Glacial drift, Water quality, Water yield, Hydrologic data, Data collections, Water levels, Hydrogeology, Stratigraphy.
Identifiers: *Cass County (N Dak).

Location and extent of the various sources of groundwater in Cass County, N. Dak. and the chemical quality of the water available from each source are described. The potential of each groundwater source for future development is evaluated. Important sources of groundwater are the sand and gravel deposits in the glacial drift and sand and sandstone beds in the Dakota Sandstone. The West Fargo aquifer, which underlies about 110 sq mi in southeastern Cass County, is the most permeable and productive aquifer in the county. It also is the most heavily pumped aquifer, and water-levels have declined seriously in the West Fargo and surrounding areas. Quality of the groundwater from major drift aquifers differs considerably from place to place. Generally the water is suitable for domestic and stock use, and some of the water is suitable for irrigation. Dissolved-solids concentration from the 7 aquifers ranges from about 380 ppm to about 1,560 ppm. The Cretaceous Dakota Sandstone is the only bedrock unit in the county that is known to yield water to wells. Dakota Sandstone water is highly mineralized and unsuitable for most uses except stock. The water has dissolved-solids concentrations ranging from about 2,600 to about 4,000 ppm. (USGS)
W70-02675

RELATION OF BEDROCK FRACTURE SYSTEMS TO UNDERGROUND WATER SUPPLIES IN THE STAFFORD SPRINGS, SOUTH CONVENTRY, SPRING HILL, AND WESTFORD QUADRANGLES,
Connecticut Univ., Storrs.
Janet M. Aitken.
Available from the Clearinghouse as PB-188 932, $3.00 in paper copy, $0.65 in microfiche. Research Project Completion Report, Dec 1969. 7 p, 8 fig, 1 append. OWRR Project A-004-CONN.

Descriptors: *Structural geology, Seismology, *Groundwater movement, Seismic properties, *Connecticut.
Identifiers: Fractures (Geology), Joints (Geology), *Fracture intersections (Geology).

Careful study of joint patterns by photo-interpretation and supplemental detailed field studies indicates that intersections of joints and foliation plany an important part in the movement of fluids through bedrock. More importantly, for the area under consideration one can demonstrate that any model based on the concept of a closed system will give an erroneous impression of movement of fluids through bedrock. This is an essential consideration in areas of thin cover and complicated structures. Seismic surveys proved useful in making broad distinctions in types of glacial cover as well as in more common use for determining thicknesses of surface and subsurface layers. The detection of shatter zones by this method is less certain but should be considered as a valid preliminary to more direct methods of exploration such as drilling.
W70-02756

2G. Water in Soils

INFILTRATION OF WATER INTO NONUNIFORM SOIL,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
Herman Bouwer.
ASCE Proc, J Irrig and Drainage Div, Vol 95, No IR4, Pap 6937, p 451-462, Dec 1969. 12 p, 5 fig, 2 tab, 11 ref, append.

Descriptors: *Infiltration, *Soil water movement, *Irrigation, *Water spreading, Percolation, Runoff, Wetting, Hydraulic conductivity, Mathematical studies, Mathematical models.
Identifiers: Nonuniform soils.

A simplified procedure for calculating infiltration into soil of nonuniform water content or hydraulic conductivity, or both, is presented. The procedure is based on the Green and Ampt model of piston flow. Input data consist of the difference in water content before and after wetting, the hydraulic conductivity after wetting, and the water entry value of the soil. Techniques for measuring these parameters in the field are briefly described. The procedure is applied to calculate infiltration-time relationships for flood irrigation of a coarse-textured and a fine-textured soil, and to evaluate the effect of nonuniform inundation time on irrigation efficiency. The results show that the usual recommendation of allowing an inundation-time difference of not more than 25% of the time required for the desired amount of water to infiltrate into soil can give irrigation efficiencies of 90% or more. Thus, larger differences in inundation time can be allowed in practice, particularly if the hydraulic conductivity of the soil decreases with depth.
W70-02447

ANALYSIS OF INFLITRATION INTO DRAINING POROUS MEDIA,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
Frank D. Whisler, and Keith K. Watson.
ASCE Proc, J Irrig and Drainage Div Vol 95, No IR4, Pap 6946, p 481-491, Dec 1969. 11 p, 13 fig, 10 ref, append.

Descriptors: *Infiltration, *Drainage, *Groundwater movement, *Soil water movement, Flooding, Irrigation, Water spreading, Numerical analysis, Saturated flow, Filtration, Hysteresis, Wetting, Drying, Recharge, Sands, Mathematical studies.
Identifiers: Wetting fronts.

Numerical analysis was applied to the inundation of a draining sand column. A method was proposed whereby hysteresis could be considered. For Botany sand, after periods of short drainage between inundations, infiltration is rapid. For longer periods of drainage the ensuing infiltration is slower, but the water moves through the media with a much steeper front. The effects of hysteresis are dynamic, depending upon the stage of drainage and the relationship used. Using a strictly wetting curve gives a better prediction than a strictly draining curve. (Knapp-USGS)
W70-02448

THE EFFECT OF GYPSUM ON THE WATER STORAGE IN A SANDY LOAM SOIL UNDER AN IRRIGATED PERENNIAL PASTURE,
Commonwealth Scientific and Industrial Research Organization, Riverina (Australia). Riverina Lab.
B. J. Bridge, and C. R. Kleinig.
International Congress of Soil Science, 9th, Adelaide, Australia, Transactions, Vol 1, p 313-323, 1968. 3 tab, 3 fig, 14 ref.

Descriptors: *Gypsum, *Soil moisture, *Irrigation efficiency, *Soil chemical properties, *Hydraulic conductivity, Soil-water-plant relationships, Semiarid climates, Soil physical properties, Clays, Clovers, Productivity, Calcium, Sodium, Magnesium, White clover, On-site investigations, Electrical conductance, Pastures, Cation exchange.
Identifiers: *Australia.

This paper describes an experiment in New South Wales, Australia, to study the effect of gypsum on a red brown soil with 34% clay content in the B horizon and low hydraulic conductivity. A split plot design was used with three replications with treatments of three irrigation frequencies. Gypsum was applied at the rate of 10 metric tons/ha. White clover was grown and harvested as a measure of productivity. Gypsum had no effect on bulk density but it significantly increased soil moisture storage at all levels of irrigation. Hydraulic conductivity of the subsoil was increased, as was exchangeable calcium, while sodium and magnesium were decreased. There was also a significantly increased production of white clover accompanying these soil changes. Average growth rate increased from 18.0 to 43.4 Kg D.M./ha/day. The gypsum produced an increased efficiency in the use of applied irrigation water. (Crouse-Arizona)
W70-02557

FACTORS DETERMINING THE HYDRAULIC CONDUCTIVITY OF RED MEDITERRANEAN SOILS AND DERIVED TYPES,
Water Planning for Israel Ltd., Tel-Aviv.
J. E. Berend, and S. Kary.
International Congress of Soil Science, 9th, Adelaide, Australia, Transactions, Vol 1, p 273-282, 1968. 2 tab, 1 fig, 9 ref.

Descriptors: *Hydraulic conductivity, *Sands, *Soil formation, *Water spreading, *Soil structure, Lime, Water table, Recharge, Carbonates, Anaerobic conditions, Citrus fruits, Clays, Soil physical properties, Reclamation, Soil profiles, Pervious soils, Dunes, Aeolian soils, Irrigated land, Agriculture, Arable land, Semiarid climates, Soil types, Leaching, Soil analysis, Percolating water.
Identifiers: *Israel.

This article reports a study of hydraulic characteristics of soils on Israel's northern coastal plain. Although annual rainfall is 450-500 mm, the evaporative potential is approximately 1.1 meter per year. This evaporation and the fact that soils have developed on sand dunes result in soil characteristics and problems similar to those of some semiarid or even arid lands. Silt and clay fractions are mainly aeolian in origin, with a wide range of textural variation. Coarse and medium textured soils are considered excellent for irrigated agriculture including citrus orchards. Aims of the study were to locate pervious soils suitable for water spreading and impervious soils suitable for water storage sites; to determine the hydraulic conductivity profile down to the water table, since impervious layers in the subsoil could interfere with the vertical movement of water; and to predict future changes resulting from various uses. Two main soil types found were: 'Hamra', with excellent physical and chemical properties for agriculture and 'Nazaz', with very high clay accumulation in the B horizon, causing low conductivity and even anaerobic conditions. A relatively high bivalent cation content resulted in good structure and maintained the hydraulic conductivity. It was concluded that good management of water spreading should replenish the carbonate content and avoid accelerated illuviation. Liming would be essential to reclaiming the pseudogley type such as the Nazzaz soil. (Crouse-Arizona)
W70-02558

SOIL FORMATION AND SALT MIGRATION IN THE MURGAB RIVER DELTA,
Akademiya Nauk SSSR, Moscow. Pochvennyi Institut.
N. G. Minashina.
International Congress of Soil Science, 9th, Adelaide, Australia, Transactions, Vol 1, p 425-435, 1968. 2 tab, 5 ref.

Descriptors: *Salinity, *Deserts, *Irrigated land, *Soil formation, *Land reclamation, Cultivated lands, Desert plants, Saline water, Irrigation canals, Clay minerals, Sands, Saline soils, Deltas, Soil chemical properties, Groundwater movement, Drying, Irrigation effects.
Identifiers: *USSR, *Kara-Kum Desert, *Murgab River Delta, Oasis.

The Murgab River forms a dry delta in the southeastern Kara-Kum Desert. The alluvium there dates from the middle Quaternary. During the process of drying out of the ancient delta, the soil changed from hydromorphic to a desert phase. While drying the soils became degraded and easily wind-blown. Silt and clay particles were blown away, and sand accumulated. Remaining clay particles helped bind the sand, stabilize the surface and permit establishment of desert vegetation. Under irrigation an oasis soil is formed, depending upon the time span of irrigation, which returns the hydromorphic phase to the soils. In some areas irrigation has been practiced for thousands of years and oasis soils have attained a depth of 3 to 4 m. The old areas plus newer lands have been brought under cultivation with irrigation from the Kara-Kum canal. The source of water, hence the main source of salt, is the Murgab. Part of the soluble salts flow out with groundwater to surrounding desert lands. The salts accumulate in soils, depressions and groundwater of these surrounding regions. The upper 10 to 13 m of soil and groundwater strata were found to be an area of active salt migration. Thus, storage of salts must be carefully considered before reclamation is undertaken of any additional land around the Murgab Oasis. (Crouse-Arizona)
W70-02565

FILTRATION PROPERTIES OF THE SOIL OF THE MOUNTAINS ON THE NORTHERN SLOPE OF TRANSILIAN ALA TAU (RUSSIAN),
Akademiya Nauk Kazakhskoi SSR, Alma-Ata. Institut Gidrogeologii i Gidrofiziki.
V. A. Sozonov, and I. S. Sosedov.
Gidrofizicheskie Issledovaniya v Gornykh Raionakh Kazakhstana Akad Nauk Kazakhskoi SSR, Trudy Instituta Gidrogeologii i Gidrofiziki, Vol 2, p 81-93, 1969. 3 fig, 2 tab, 12 ref.

Descriptors: *Filtration, *Soil physical properties, *Soils, *Soil water movement, *Slopes, Mountains, Groundwater, Runoff, Floods, Sprinkling, Geology, Vegetation, Altitude, Forests.
Identifiers: *USSR, Transilian Ala Tau, Soil filtration properties.

Filtration intensities, filtration coefficients and the effects of altitude and vegetation on the filtration in soils were investigated in the Transilian Ala Tau. The effects of these parameters on the filtration properties of the Ala Tau soils are given as the coefficients of filtration versus time and versus altitude and soil composition. (Gabriel-USGS)
W70-02652

DEVELOPMENT OF A MATHEMATICAL MODEL FOR THE SIMULATION OF FLATLAND WATERSHED HYDRAULICS,
Iowa State Water Resources Research Inst., Ames.
Darrell W. Deboer, and Howard P. Johnson.
Doctoral Thesis, Available from the Clearinghouse as PB-188 793, $3.00 in paper copy, $0.65 in microfiche. Completion Report, Iowa State Water Resources Research Institute, Nov 1, 1969. 255 p, 17 tab, 66 fig, 105 ref, 13 append. OWRR Project A-024-IA

Descriptors: *Mathematical model, Watershed hydraulics, Drainage, Iowa, *Subsurface drainage, *Drainage effects, *Simulation, Hydrologic model, Drainage systems.
Identifiers: *Artificial drainage.

Many acres of midwestern agricultural lands have artificial drainage. The primary reason for artificial drainage is to accelerate the removal of excess water from the soil surface (surface drainage) and the crop root zone (subsurface drainage). The hydraulics and hydrology of excess water removal from agricultural lands by artificial means is not well understood. The primary objective was to develop and test a mathematical watershed model which could reflect the effect of artificial drainage and hydrologic parameter variations on watershed hydrographs. A hydrologic mathematical watershed model was developed for the most recently glaciated region of Iowa. The region is characterized by a flat topography, numerous shallow depressional areas commonly called 'potholes', and surface and subsurface drainage systems. The research effort was based on a previously developed hydraulic mathematical watershed model which simulated the movement of excess water from the depressional areas to the watershed outlet. The hydraulic model used excess water as input to simulate watershed hydrographs. The developed hydrologic model uses precipitation as input and simulates the hydrologic watershed processes of infiltration, surface runoff to depressional areas, soil moisture profile storage, evapotranspiration and percolation of water to the water table. The model simulates the hydrology of a watershed from precipitation input to a watershed outflow hydrograph on an individual storm basis. The model was used to simulate five individual hydrologic events for the 24 square mile East Fork Hardin Creek Watershed, Green County, Iowa. The model simulated hydrographs corresponded in shape with field measured outflow hydrographs. The peak discharge deviation between simulated and actual hydrographs varied from -8 to 29 percent with an 8 percent mean deviation.
W70-02676

WATER REPELLENT SOILS: A WORLDWIDE CONCERN IN MANAGEMENT OF SOIL AND VEGETATION,
Forest Service, (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.
For primary bibliographic entry see Field 04A.
W70-02686

SOIL AND WATER MANAGEMENT FOR SALINITY CONTROL,
New Mexico State Univ., University Park.
Harold E. Dregne, and Peter J. Wierenga.
Project Completion Report, Aug 31, 1969. 3 p. OWRR Project C-1361.

Descriptors: *Salts, *Saline soils, *Water quality, Lysimeters, Leaching, Soil-water movement, Hydraulic conductivity.
Identifiers: *Salinity sensors.

Lysimeters five feet high and 2.5 feet in diameter have been instrumented with tensiometers, suction cups, salinity sensors and thermocouples, with provision for automatic data recording. A constant suction was maintained at the bottom of the lysimeters. Upon irrigation of the columns drainage rates remained at a high level for several days. Average drainage rates were 0.74 mm/day, 0.26 mm/day and 0.12 mm/day, respectively, at 25, 50 and 75 after irrigation with no evaporation from the soil surface. Since the salt concentration of the drainage water was relatively high, this indicates that appreciable salt is moved down the soil profile under unsaturated soil water conditions.
W70-02729

DYNAMIC BEHAVIOR OF SOIL,
Rhode Island Univ., Kingston. Dept. of Civil Engineering; and Rhode Isand Univ., Kingston. Dept. of Ocean Engineering.

For primary bibliographic entry see Field 08E.
W70-02751

GROUND WATER SEEPAGE PATTERNS TO WELLS FOR UNCONFINED FLOW,
Iowa State Univ, Ames. Dept. of Agronomy.
Don Kirkham.
Available from the Clearinghouse as PB-188 910, $3.00 in paper copy, $0.65 in microfiche. Iowa State Water Resources Research Institute, Completion Report, Dec 1969. 9 p, 1 tab, 3 fig. OWRR Project B-002-IA.

Descriptors: *Dupuit-Forchheimer theory, *Flow nets, *Theoretical analysis, Groundwater, Free surfaces, Seepage, Wells, Piezometry, Computer programs.

Dupuit-Forchheimer theory for free surfaces of semi-confined flow has been theoretically investigated as to why the theory fails to predict free surfaces near an outflow sink. It is shown that the theory does indeed give correct free surfaces if the flow medium is of infinite conductivity in the vertical seepage direction as compared with the horizontal. The theory gives non-orthogonal flow nets and examples have been worked out. In another aspect of the research, analytical theory has been developed and digitally computerized to give the free surface for dam seepage; the theory can be modified for well seepage. The present analytical theory needs further development.
W70-02759

2H. Lakes

DENSITY STRATIFIED LAKES IN NORTHERN ELLESMERE ISLAND,
Defence Research Establishment Ottawa, Ontario; and Smithsonian Institution, Washington, D.C. Radiation Biology Lab.
G. Hattersley-Smith, J. E. Keys, H. Serson, and James E. Mielke.
Nature, Vol 225, No 5227, p 55-56, Jan 3, 1970. 2 p, 2 fig, 1 tab, 9 ref.

Descriptors: *Lakes, *Arctic, *Cold regions, *Density stratification, Salinity, Mixing, Diffusion, Sea water.
Identifiers: *Ellesmere Island, Canada.

Lake Tuborg, northern Ellesmere Island (lat 80 deg 50 minN, long 79 deg W) was found to have density stratification. Other lakes in the area show the same phenomenon. All the lakes were formed by isolation of arms of fjords by glacial advances or relative sea-level changes. The lakes are nearly fresh in the upper 5-10 m, and below this depth salinity increases to the bottom. The saline water is probably trapped old sea water. Inflowing fresh water has replaced surface sea water. The stratification is highly stable and is controlled almost entirely by salinity, with temperature playing only a minor part. (Knapp-USGS)
W70-02446

SOME EXPERIENCE IN THE STUDY OF THE DYNAMICS OF A BENTHONIC WATER LAYER IN THE NEAR-SHORE ZONE OF RESERVOIRS (RUSSIAN),
V. G. Bybka.
In: Vodnye Resursy i Vodnoe Khozaystvo Sibiri (Water Resources and Water Economy of Siberia), Akad Nauk SSSR, Sibirskoye Otdelenie, Geogr Obshchestvo, Novosibirsk, USSR, p 95-101, 1968. 7 p, 2 fig, 5 ref.

Descriptors: *Reservoirs, *Hydrodynamics, *Water levels, *Shores, *Zoning, Turbulence, Topography, Slope stability, Waves (water), Streamflow, Water pressure, Sedimentation, Erosion.
Identifiers: *USSR, Shore-zone reservoir dynamics.

The dynamics of benthonic water layers was investigated on the basis of laboratory and experimental data recorded at the Novosibirsk water reservoir. The distribution and variations in the near-bottom pressures and the transfer of water and sediment load in the near-bottom layers are intimately associated with the degree of deformation of surface waves and with the shore relief. The positive pressures are characterized by their absolute values and the negative pressures are characterized by their considerable duration lengths. The erosion and transfer of material in an erosion zone is due to the presence of a wave whose duration activity is comparable with that of an inverse flow. (Gabriel-USGS)
W70-02483

THE IMPORTANCE OF PROTOZOA IN CONTROLLING THE ABUNDANCE OF PLANKTONIC ALGAE IN LAKES,
Freshwater Biological Association, Ambleside (England).
Hilda M. Canter, and J. W. G. Lund.
Proceedings of the Linnean Society of London, Vol 179, No 2, p 203-219, June 1968. 4 fig, 2 tab, 4 plates, 24 ref, appendix.

Descriptors: *Protozoa, *Lakes, *Grazing, *Herbivores, *Algae, *Chlorophyta, Food chains, Food webs, Parasitism, Ecology, Aquatic productivity, Plankton, Life cycles, Productivity, Phytoplankton.
Identifiers: *Algal control, English Lake District, Esthwaite Water, Lake Windermere, Blelham Tarn, Eudorina elegans, Dictyosphaerim pulchellum, Coenococcus planctonicus, Gemellicystis imperfecta, Paulschulzia tenera, Paulschulzia pseudovolvox, Sphaerocystis schroeteri, Pseudosphaerocystis lacustris, Pseudosphaerocystis neglecta, Pseudosphaerocystis lundii, Synura, Pseudospora, Heliozoa.

Protozoa are described of the genus Pseudospora, which feed on and destroy the colonial flagellate algae, Eudorina elegans and Synura sp, and the colonial green mucillage-embedded algae, Dictyosphacrium pulchellum, Coenococcus planctonicus (Eutetramorus lundii), Gemellicystis imperfecta (Pseudosphaerocystis lacustris, P neglecta, P lundii), Paulschulzia tenera (P pseudovolvox), and Sphaerocystis schroeteri (sensu lato). These grazing herbivores, and others known from previous studies, may be important ecological agents in relationships between primary and secondary production. In waters of the English Lake District, the planktonic mucillage-embedded green algae populations were, for the first time, shown to be decimated in short periods following the appearance of a few of the appropriate protozoans within their colonies. As algal numbers decreased, the percentage of algal colonies containing protozoa increased. Infestations occurred primarily during spring and summer when colonial green algae were most common. Results of experiments with laboratory cultures suggested a high degree of specificity of Pseudospora sp for host algae despite close morphological relationships among the algae. The protozoa were described in some detail as to life cycle: free swimming, feeding amoeboid, and encysted stages; and as to peculiarities in method of attack on algae. (Gerhold-Wisconsin)
W70-02500

REPORT ON THE NUTRIENT SOURCES OF LAKE MENDOTA.
Wisconsin Univ., Madison.
For primary bibliographic entry see Field 05B.
W70-02506

FRESHWATER PRIMARY PRODUCTION BY A BLUE-GREEN ALGA OF BACTERIAL SIZE,
Nature Conservancy, Edinburgh (Scotland); Freshwater Biological Association, Ambleside, (England).
A. E. Bailey-Watts, M. E. Bindloss, and J. H. Belcher.
Nature, Vol 220, No 5174, p 1344-1345, Dec 1968. 3 fig, 12 ref.

Descriptors: *Fresh water, *Primary productivity, *Cyanophyta, *Nannoplankton, *Size, Photosynthesis, Lakes, Depth, Ecology, Phytoplankton, Distribution, Diatoms, Seasonal, Chlorophyll, Eutrophication, Trout, Cultures, Metabolism, Growth rates, Electron microscopy, Biomass, Aquatic microorganisms, Spectrophotometry, Chlorophyta.
Identifiers: Morphology, Abundance, Synechoccus, Loch Leven (Scotland), Euphotic zone, Algal blooms, Extracellular substances, Scotland, Kinross (Scotland), Winkler technique, Chlorophyceae, International Biological Program, Phase contrast microscopy, Microtubules, Photosynthetic lamellae, Chlorophyll a.

Minute rod-shaped organisms, occasionally present in almost pure stands, colored green a shallow freshwater lake in Scotland. Authors studied its morphology, temporal abundance, and spatial distribution, and measured gross photosynthetic production to determine whether it is a bacterium or cyanophyte (blue-green alga). It was culture studied with light microscopy (transmitted light or phase contrast illumination) and with electron microscopy. Microanatomy showed conclusively that it is a cyanophyte of bacterial proportions, with cylindrical bundles of microtubules at end of each cell, a feature apparently previously unrecorded in cyanophytes. It is apparently an undescribed species of the genus Synechococcus. The phytoplankton standing crop was estimated regularly; gross photosynthetic production measured fortnightly. Present in small amounts throughout winter, numbers of Synechococcus gradually rise beginning in late April, and in June and July, account for over 90% of the estimated total live crop volume. Evidence suggests that, with increasing eutrophication of the loch, blooms have become more common and persistent, those composed of cyanophytes being associated with poor fishing. Whether this species forms part of those blooms is unknown, since untrained observers might easily have mistaken it for a bacterium. (Jones-Wisconsin)
W70-02508

MODERN HYDROCARBONS IN TWO WISCONSIN LAKES,
Princeton Univ., N.J. Dept. of Geology; and Shell Oil Co., Houston, Tex. Technical Services Div.
Sheldon Judson, and Raymond C. Murray
Bulletin of the American Association of Petroleum Geologists, Vol 40, No 4, p 747-750, Apr 1956. 1 fig, 5 ref.

Descriptors: *Lakes, *Wisconsin, Carbon radioisotopes, Sediments, Diagenesis, Organic matter, Chemical analysis, Oxygenation, Oxidation, Eutrophication, Oligotrophy.
Identifiers: *Hydrocarbons, Lake Mendota (Wis), Trout Lake (Wis), Carbon-14, Chemical processes, Sludge-marl sediments, Gyttja, Hydrocarbons (Dead), Hydrocarbons (Modern).

The content of radiocarbon (carbon-14) was determined in bottom sediments of two large Wisconsin lakes: eutrophic Lake Mendota, located in the southern part of the state, and oligotrophic Trout Lake, located near the Michigan boundary. The black sludge-buff marl sediment of Lake Mendota averaged 11% of organic matter and 232 ppm (parts per million) of hydrocarbon; the olive green gyttja of Trout Lake contains about 45% of organic matter and only 277 ppm of hydrocarbon. This discrepancy is attributed to the difference in the nature of organic matter and the level of oxygenation. In contrast with highly oxidizing conditions of Trout Lake, the deficiency of oxygen in Lake Mendota precludes the destruction of hydrocarbons. The radiocarbon activity, detected in sediments of both lakes, indicated that these compounds are of recent origin and not 'dead' constituents of contamination. (Wilde-Wisconsin)
W70-02509

INTERRELATIONS OF DISSOLVED ORGANIC MATTER AND PHYTOPLANKTON,
Michigan Univ., Ann Arbor. Dept of Zoology.
For primary bibliographic ent ry see Field 05C.
W70-02510

A LIMNOLOGICAL COMPARISON OF TWELVE LARGE LAKES IN NORTHERN SASKATCHEWAN,
Saskatchewan Univ., Saskatoon. Dept. of Biology.
D. S. Rawson.
Limnology and Oceanography, Vol 5, p 195-211, 1960. 1 fig, 4 tab, 28 ref.

Descriptors: *Limnology, *Lakes, Benthic fauna, Oligotrophy, Precambrian eras, Eutrophication, Productivity, Temperature, Stratification, Dissolved oxygen, Bottom sediments, Hypolimnion, Hydrogen ion concentration, Dissolved solids, Oligochaetes, Light penetration, Color, Plankton, Lake morphology, Amphipoda, Cisco, Trout, Pikes, Suckers, Diatoms, Copepods, Chlorophyta, Cyanophyta, Biomass, Sampling.
Identifiers: *Saskatchewan (Canada), Canada, Morphometric data, Mineral content, Mesotrophy, Chironomids, Sphaeriids, Mysis, Pontoporeia, Pickerel, Bubot, Edaphic factors.

Biomasses in 12 large lakes of northern Saskatchewan vary greatly. Five eutrophic lakes on glacial drift have standing plankton crops, bottom organisms, and fish, several times greater than five oligotrophic lakes on Precambrian Shield. Lakes straddling the margin of the Shield are mesotrophic. Underlying reasons for oligotrophy in Shield lakes and increasing eutrophy in more southerly lakes may be edaphic. Since most northern lakes are deep, and most south of the Shield are shallow, this morphometric difference accentuates edaphic influences. Climate also may contribute to differences in biological production. Comparisons between individual lakes of the Precambrian group suggest that morphometric conditions in this group are perhaps less effective than edaphic, particularly in unique Frobisher Lake. Comparisons of five lakes on the glacial drift suggest that continuous mixing of eutrophic Big Peter Pond increases productivity, while rapid flushing of Ile a la Crosse results in markedly decreased production. Eight characteristics--three biological and five physical--appear useful in classifying these lakes. Ranking each lake with respect to these quantified characteristics and comparing summed values may be useful, especially in connection with fish management. (Jones-Wisconsin)
W70-02511

MOUNTAIN AND DESERT LAKES IN SOUTHERN KAZAKHSTAN, THEIR RESOURCES AND METHODS OF ECONOMIC DEVELOPMENT,
G. G. Muravlev.
Translated from Akademiia Nauk Kazakhskoi SSR, Vestnik, p 38-45, Oct 1967. JPRS Translation 45063, April 1968. 12 p.

Descriptors: *Lakes, *Arid lands, *Multiple purpose, *Natural resources, *Resource development, Geologic formations, Geology, Phreatophytes, Surface waters, Groundwater, Mineral water, Fresh water, Fish management, Economics, Mountains, Structural geology.
Identifiers: *USSR, *Kazakhstan.

The author presents a broad coverage of literature on geologic history and structure and on resources of numerous lakes of Southern Kazakhstan, USSR, together with a discussion of implications regarding resources and their economic development. He divides them broadly into mountain fresh water lakes and desert lakes of a generally shallow nature, with either fresh or mineralized water. The mountain lakes are supplied by surface waters of brooks and rivers and groundwaters of local origin. Glacial melt becomes important at higher elevations. The desert lakes have the same basic sources but from mountains rather than local runoff, which is negligible. Resources of these high quality, freshwater mountain lakes are limited to few fish and recreation potential as yet unrealized because of inadequate roads. The desert lakes are relatively rich in resources: abundant fish and crustaceans, moisture-loving plants, many shore animals such as muskrats, fresh or mineralized water, mineral bottoms, coastal deposits, recreation potential and a potential for growing valuable water plants such as rice. However, the resources may be unstable owing to climatic and water fluctuations. The author proposes that potential economic value of these lakes can only be realized in full through planned long term management: procedures such as structures to stabilize the water level and replacing 'trash' fish with valuable commercial species. (Crouse-Arizona)
W70-02564

NUTRIENT LIMITATION OF SUMMER PHYTOPLANKTON GROWTH IN CAYUGA LAKE,
Cornell Univ., Ithaca, N.Y.
For primary bibliographic entry see Field 05C.
W70-02643

LAKE TYPES AND LAKE SEDIMENTS,
Copenhagen Univ. (Denmark). Geographical Lab.
Kaj Hansen.
Verh Internat Verein Limnol, Vol 14, p 285-290, July 1961. 2 fig, 2 tab, 6 ref.

Descriptors: *Lakes, *Lake soils, Eutrophication, Oligotrophy, Dystrophy, Diatoms, Sediments, Calcium carbonate, Peat, Diagenesis.
Identifiers: *Lake typology, Rations (Carbon/Nitrogen), Polyhumous sediments, Silicon dioxide, Tyrfopel, Dy, Gyttja, Oligohumous sediments, Denmark, Sweden, Ortho-eutrophic lakes, Para-eutrophic lakes, Ortho-oligotrophic lakes, Para-oligotrophic lakes.

Lake sediments with C/N (carbon-to-nitrogen) ratio of 10 or less should be classified as gyttja, whereas those of higher ratio as dy. With an increase in the content of acid humus and C/N ratio, the dy changes to tyrfopel, as the initial phase of peat formation. The suggested classification of lake sediments is based on two ordinates. The Y axis of C/N ratios from 0 to 20 delineates the oligohumous or gyttja sediments from the polyhumous sediments of dy and tyrofopel types. The X axis expresses 0 to 100% contents of calcium carbonate plus alkali soluble silicon dioxide of diatom frustules. The gyttja of oligohumous oligotrophic lakes originates chiefly from the benthos vegetation and consists in a large part of mineral matter; the gyttja of eutrophic lakes is predominantly of planktonic nature. The paper stresses shortcomings of previous classifications by Thienemann (Die Binnengewasser Mitteleuropas. Binnengewasser I, Stuttgart, 1925), Naumann (Grundzuge der regionalen Limnologie, Binnengewasser II, Stuttgart 1932) and Berg (Berg K. and Petersen, I. C. Studies on the Humic Acid, Lake Gribso. Folia Limnol. Scand. No. 8, 1956). (Wilde-Wisconsin)
W70-02683

THE SUCCESSION OF 'BLOOM' SPECIES OF BLUE-GREEN ALGAE AND SOME CAUSAL FACTORS,
Saskatchewan Univ., Saskatoon.
U. T. Hammer.
Verh Internat Verein-Limnol, Vol 15, p 829-836, Feb 1964. 3 fig, 1 tab, 5 ref.

Descriptors: *Cyanophyta, *Environmental effects, *Succession, Ecology, Lakes, Distribution, Temperature, Salinity, Phosphates, Sampling, Semiarid climates, Precipitation (Atmospheric), Ice, Chemical analysis, Scum, Seasonal, Physiological ecology, Water pollution effects, Eutrophication, Cycling nutrients, Nutrient requirements, Calcium, Magnesium, Sodium, Carbonates, Sulfates.
Identifiers: *Bloom species, Saskatchewan (Canada), Hudson Bay (Canada), Orthophosphates, Physical analysis, Species interactions, Anabaena flos-aquae, Aphanizomenon flos-aquae, Lyngbya birgei, Microcystis aeruginosa, Oscillatoria prolifica, Oscillatoria rubescens.

Results are reported of investigations of ecological relationships of planktonic cyanophytes (blue-green algae), primarily those species which formed water blooms. Twenty-three lakes in southern Saskatchewan, Canada, were periodically examined during periods of 1-3 years. Distribution and bloom production of some of these species with respect to water salinity and temperature, orthophosphate concentration, and species interaction are discussed. Lake waters sampled varied from fresh water to extremely saline. Five freshwater lakes are of the carbonate type, while the others are sulphate lakes; none can be classified as chloride types. The bloom-producing species found were Anabaena flos-aquae, Aphanizomenon flos-aquae, Lyngbya birgei, Microcystis aeruginosa, Oscillatoria prolifica, and Oscillatoria rubescens. Temporally, blooms appeared in the following order: Anabaena, Microcystis, and Aphanizomenon. Numbers of Anabaena usually declined with or before onset of other blooms. Water temperature influenced the time of appearance and sequence of bloom formation. Optimum orthophosphate concentrations varied for different species. Accumulation and storage of orthophosphate by algae, its subsequent use in bloom production, and its liberation into the water upon bloom decomposition was evident. Species interaction apparently played a role in bloom persistence and periodicity. (Jones-Wisconsin)
W70-02684

COOLING WATER STUDIES AT ELECTRIC POWER STATION,
Duke Power Co., Charlotte, N.C.
For primary bibliographic entry see Field 05B.
W70-02713

DENSITY FLOW REGIME OF ROOSEVELT LAKE,
Battelle Memorial Inst., Richland, Wash. Dept. of Environmental Health and Engineering; and Bureau of Commercial Fisheries, Seattle, Wash. Fish Passage Research Program.
Robert T. Jaske, and George R. Snyder.
Journal of the Sanitary Engineering Division, Proceed of ASCE, Vol 93, No SA3, p 15-28, June 1967. 11 fig, 9 ref.

Descriptors: *Density currents, *Thermal stratification, *Reservoirs, Flow, Temperature, Columbia river.
Identifiers: Canadian Treaty, Flow regime, Lake Roosevelt, Interfacial layers.

The thermal regime of Lake Roosevelt for the summers of 1964 and 1965, when compared with Yih and the Laboratory studies of Debler, shows good agreement regarding the position of the interfacial layer between the upper, relatively stagnant zone and the region of primary flow transport. Further study of the temperature data and confirmation by a limited amount of current measurement shows the location of a second, lower interface roughly conforming to the upper boundary. During the season when stratification occurs, the resulting jet flow travels in a flat, undulating fashion, at times rising above the level of the discharge. Existing theory appears inadequate to fully predict this behavior, although an empirical relationship can be derived to perform engineering analysis. The study confirms the necessity to consider density currents in the management of special releases and in thermal and chemical material balances. Furthermore, the dynamic conditions within the reservoir distort the resulting flow jets to the extent that cooler masses can be by-passed. Another result is the blocking of the formation of 'normal' current jets, and, as a consequence, Lake Roosevelt fills with cool water by displacement from the north without any significant horizontal redistribution. (Rietveld-Vanderbilt)
W70-02716

PHYTOPLANKTON FLORA OF NEWFOUND AND WINNISQUAM LAKES, NEW HAMPSHIRE,
New Hampshire Univ., Durham. Dept. of Botany.
For primary bibliographic entry see Field 05C.
W70-02764

PHYSICAL, CHEMICAL, BACTERIAL, AND PLANKTON DYNAMICS OF LAKE PONTCHARTRAIN, LOUISIANA,
Louisiana Water Resources Research Inst., Baton Rouge.
For primary bibliographic entry see Field 05C.
W70-02766

PHYTOPLANKTON POPULATIONS IN RELATION TO TROPHIC LEVELS OF LAKES IN NEW HAMPSHIRE, U.S.A.
New Hampshire Univ., Durham. Dept. of Botany.
For primary bibliographic entry see Field 05C.
W70-02772

CLADOCERAN FAUNAS ASSOCIATED WITH AQUATIC MACROPHYTES IN SOME LAKES IN NORTHWESTERN MINNESOTA,
Minnesota Univ., Minneapolis. Limnological Research Center.
Henry W. Quade.
Ecology, Vol 50, No 2, p 170-179, 1969. 8 fig, 1 tab, 19 ref.

Descriptors: *Aquatic animals, *Lakes, *Minnesota, Chara, Littoral, Dynamics, Ecology, Daphnia, Alkalinity, Sulfates, Dissolved solids, Depth.
Identifiers: *Cladoceran, *Macrophytes, Lake Itaska (Minn), Autecology, Squaw Lake (Minn), Long Lake (Minn), Elk Lake (Minn), Lake Morrison (Minn), Lake Mary (Minn), Bad Medicine Lake (Minn), Tulaby Lake (Minn), Chydoridae, Sididae, Bosminidae, Daphnidae, Macrothricidae, Polyphemidae, Ceratophyllum demersum, Naias flexilis, Potamogeton natans, Nuphar variegatum, Community coefficient, Per cent similarity.

Cladoceran faunas associated with twelve species of aquatic macrophytes were studied to determine whether Cladocera showed community preference to specific plants. Almost 3000 specimens belonging to 38 Cladocera species were counted. Forty-two collections were made in seven lakes near Lake Itasca (northwest Minnesota), using SCUBA to select appropriate single-species stands of the twelve plants. Some grouping was evident upon tabulating all collections from each plant specie. The cladoceran communities resulted in a breakdown of plants into five groups: broad-leaved submersed, fine-leaved submersed, floating-leaved, Chara, and others. Water depth and sediment type did not seem to limit distribution of those plant groups that showed specific cladoceran associations. Upon grouping all cladoceran collections from a single lake, two limnologically similar lakes showed distinct cladoceran faunas. Two measurements of community type, namely coefficient of community and per cent similarity, were calculated, the latter giving better results. These measurements supported the hypothesis that aquatic macrophytes control the distribution of the littoral Cladocera. The hypothesis could be further evolved by testing one plant species in many lakes or many plant species in one lake. (Jones-Wisconsin)
W70-02789

THE OBLITERATION OF THE HYPOLIMNION,
Yale Univ., New Haven, Conn. Osborn Zoological Lab.
For primary bibliographic entry see Field 05C.
W70-02797

SOME PHYSICAL AND CHEMICAL FACTORS IN THE METABOLISM OF LAKES,
Saskatchewan Univ., Saskatoon.
D. S. Rawson.
American Association for Advancement of Science Bulletin, Vol 10, p 9-26, 1939. 6 fig, 81 ref.

Descriptors: *Lakes, *Metabolism, Eutrophication, Manganese, Oligotrophy, Oxidation-reduction potential, Dystrophy, Silica, Lake morphometry, Organic matter, Depth, Inhibitors, Epilimnion, Hypolimnion, Benthic fauna, Geology, Temperature, Thermal stratification, Turnovers, Cisco, Trout, Oligochaetes, Oxygen, Thermocline, Methane, Hydrogen sulfide, Hydrogen ion concentration, Calcium, Phosphorus, Nitrogen, Nitrogen compounds, Iron.
Identifiers: *Physical factors, *Chemical factors, Stagnation (Winter), Ooze, Stagnation (Summer), Biological deserts, Trophogenic zones, Oxidation (Bacterial), Transparency, Oxygen excess, Ratio (Oxygen/carbon dioxide), Microcosms, Littoral development, Alkalitrophic lakes, Siderotrophic lakes, Grote's ecological spectrum, Autochthonous sources, Allochthonous sources.

A comprehensive review of physical and chemical factors influencing the composition of lake waters is presented. The essay is of special importance for a novice in eutrophication research and contains a classic figure delineating relationships between geographic locations of lakes and their trophic nature. The paper critically assesses oxygen deficits as a factor in lake metabolism and concludes that this parameter is most valuably considered in terms of rates on a daily basis rather than as standing quantities. Effects of oxygen as a limiting factor are often confounded with those of concentrations of carbon dioxide and hydrogen sulfide, and of low temperatures. This early paper was among the first to indicate the need for research in the dynamic fine structure including rates of utilization and transfer of the cycling nutrients, nitrogen and phosphorus. (Wilde-Eichhorn--Wisconsin)
W70-02798

ON THE RELATION BETWEEN THE OXYGEN DEFICIT AND THE PRODUCTIVITY AND TYPOLOGY OF LAKES,
Yale Univ., New Haven, Conn. Osborn Zoological Lab.
G. Evelyn Hutchinson.
Internationale Revue der gesamten Hydrobiologie u Hydrographie, Vol 36, p 336-355, 1938. 1 fig, 1 tab, 41 ref.

Descriptors: *Oxygen, *Productivity, *Lakes, Hypolimnion, Plankton, Limnology, Methane, Lake Mendota (Wis), Standing crop, Organic matter, Oligotrophy, Areal, Epilimnion, Depth, Volumetric analysis, Productivity, Eutrophication, Dystrophy, Turnovers, Thermal stratification.
Identifiers: *Oxygen deficit, *Lake typology, Iodine, Crater lakes, Green Lake (Wis), Fureso (Denmark), Calorific values, Devil's Lake (Wis), Geneva Lake (Wis), Okauchee Lake (Wis), Elkhart Lake (Wis), Garvin Lake (Wis), Desmids, Pallett Lake (Wis), Morphometric oligotrophy, Eifel (Germany), Germany, Bulgaria, Himalayas, Edaphic oligotrophy, Mysis oculata relicta.

In lakes where hypolimnetic oxygen is exhausted 'real oxygen deficit' is defined as 'apparent oxygen deficit', directly determined, plus the oxygen equivalent of methane, iodine reducing compounds, and other compounds not found in presence of abundant oxygen. Real oxygen deficit may be calculated on actual or absolute basis. In Wisconsin lakes (Green, Black Oak, and Mendota) and the Danish Fureso, rates of development of the absolute hypolimnetic oxygen deficit per square centimeter of hypolimnetic surface, is proportional to mean standing crop of plankton per unit area of lake surface. Strom's method of using hypolimnetic deficit, referred to unit area, as measure of productivity, is justified for harmonic temperate lakes. In Mendota and Fureso, deficit developed in one month, when compared to planktonic organic matter on an energetic basis, approximately represents mean standing crop. Areal deficit in some lakes in different districts is considered. In lakes with maximum depths of 50-75 meters, a complete range from unproductive to productive is found. Mean areal deficit of several lakes in a single district gives useful characterization of its regional limnology. Lundbeck's distinction between primary (edaphic) and secondary (morphometric) oligotrophy is fundamentally important in lake typology. (Jones-Wisconsin)
W70-02799

SEDIMENTARY PHOSPHORUS IN LAKE CORES--OBSERVATIONS ON DEPOSITIONAL PATTERN IN LAKE MENDOTA,
Wisconsin Univ., Madison. Water Chemistry Lab.
Dennis A. Wentz, and G. Fred Lee.
Environmental Science and Technology, Vol 3, No 8, p 754-759, Aug 1969. 5 fig, 1 tab, 20 ref.

Descriptors: *Lakes, *Phosphorus, *Lake sediments, *Cores, Wisconsin, Sludge, Eutrophication, Nutrients, Cycling nutrients, Sediment-water interfaces, Sewage effluents, Water pollution effects, Carbonates, Soil chemistry, Water chemistry, Water pollution sources, Aquatic productivity, Urbanization, Carbon cycle, Iron, Organic matter, Manganese, Sorption, Diagenesis, Marl.
Identifiers: *Lake Mendota (Wis), Phosphorus (Available), Phosphorus (Total), Cultural eutrophication, Autochthonous materials, Freundlich equation, Ratio analysis, Clastic materials, Apatite.

Available P (phosphorus) is an operationally defined fraction of lake sediments available for plant growth. A core, from the deepest part of eutrophic Lake Mendota, Wisconsin, has been analyzed for available P by a method previously described. Ratio, available P/total P, generally ranges between 0.4 and 0.7 in lake sediments. The ratios in the core are examined and conslusions are made regarding deposition of available P in the lake: clastic materials/carbonate carbon, organic carbon/carbonate carbon, available P/carbonate carbon, available P/clastic materials, available P/iron, and iron/carbonate carbon. Deposition rate of available P was constant in marl layer, increased concomitantly with a change from marl to sludge, was maximal about 30 centimeters below sediment-water interface, and decreased gradually from that stratum to surface. Initial increases may correspond with man's appearance in the watershed. Decrease may correspond with cessation of input of city of Madison's sewage effluents in 1899. Evidence derived from this study suggests that available P is probably associated with carbonate portion of the sediments, and that changes in its deposition correlate with events influencing the eutrophication of the lake. (Eichhorn-Wisconsin)
W70-02800

SEDIMENTARY PHOSPHORUS IN LAKE CORES--ANALYTICAL PROCEDURE,
Wisconsin Univ., Madison. Water Chemistry Lab.
For primary bibliographic entry see Field 05A.
W70-02801

EUTROPHICATION AND SENESCENCE IN A GROUP OF PRAIRIE-PARKLAND LAKES IN ALBERTA, CANADA,
For primary bibliographic entry see Field 05C.
W70-02802

2I. Water in Plants

ALFALFA WATER TABLE INVESTIGATIONS,
Agricultural Research Service, Reno, Nev. Soil and Water Conservation Research Div.
Rhys Tovey.
ASCE Proc, J Irrig and Drainage Div, Vol 95, No IR4, Pap 6974, p 525-535, Dec 1969. 11 p, 7 fig, 1 tab, 7 ref.

Descriptors: *Evapotranspiration, *Consumptive use, *Alfalfa, *Groundwater movement, *Water level fluctuations, Water table, Irrigation, Irrigation water, Irrigation efficiency, Water demand, Water utilization, Lysimeters, Soil moisture.

Identifiers: Water use (Alfalfa).

Use of water by alfalfa growing under high water table conditions was studied to determine the irrigation requirement. A three-season average of consumptive use and yield of alfalfa, disregarding soil textures, showed an almost straight-line relationship with water table depth for the nonirrigated treatment. The nonirrigated alfalfa showed the effects of static water table depth on the consumptive use and yield of alfalfa. Peak consumptive use occurred when the alfalfa was at or approaching the one-tenth bloom stage and temperatures were high. Only minor differences in the growth of alfalfa were found for the various static water table, soil, and irrigation treatments. The alfalfa plants in the lysimeters showed good root development, with roots in the saturated zone and enlarged white rootlets extending below the water table level. Pan evaporation, net radiation, and the Olivier method adequately predicted cumulative consumptive use for an 8-ft water table, but were low for 2-ft and 4-ft water table depths. None of the prediction methods reflected peak consumptive use periods for alfalfa grown in the presence of static shallow water tables. (Knapp-USGS)
W70-02450

GERMINATION STUDIES OF PERENNIAL GRASS SEEDS,
Central Arid Zone Research Inst., Jodhpur (India).
L. D. Ahuja, and C. P. Bhimaya.
Annals of Arid Zone, Vol 6, No 2, p 146-152, 1967. 3 tab, 11 ref.

Descriptors: *Arid lands, *Range grasses, *Germination, *Seeds, *Economic efficiency, Range management, Ranges, Seed treatment, Plant physiology, Economics, Research and development, Natural resources, Livestock, Revegetation, Sands, Grasses, Deserts.
Identifiers: *Range rehabilitation, *Perennial grasses, *Rajasthan, India, Reseeding.

The economy of arid Western Rajasthan, India, is closely linked to the livestock industry which must utilize seriously deteriorating ranges. Successful range management will depend upon successful reseeding of appropriate perennial grasses. It is necessary to know germination characteristics and requirements of grasses suited to the area in order to conduct successful and economically efficient range rehabilitation. Germination trials of five species were conducted in petri dishes and in a sand medium. The petri dish trials were found unsuitable. Results of the germination trials in the sand medium are presented in tables. Germination percentages varied significantly between species, with averages ranging from 73.1 to 28.2 percent. Possible physiological reasons for the differences are discussed briefly. (Crouse-Arizona)
W70-02552

PHYTOSOCIOLOGICAL VARIATIONS IN FLORISTIC COMPOSITION OF THE VEGETATION IN THE ARID ZONE: I. MONSOONAL VEGETATION OF THE ALLUVIAL PLAINS,
Central Arid Zone Research Inst., Jodhpur (India).
Y. Satyanarayan, and Y. D. Gaur.
Annals of Arid Zone, Vol 6, No 2, p 178-199, 1967. 6 tab, 3 fig, 28 ref.

Descriptors: *Arid lands, *Ecology, *Vegetation, *Plant populations, *Plant growth, Alluvium, Ranges, Weeds, Plants, Desert plants, Forages, Xerophytes, Germination, Growth stages, Seeds, Hot winds, Moisture availability, Moisture stress, Soil moisture, Monsoons, Wet seasons, Dry seasons, Climatic data, Competition, Vegetation establishment.
Identifiers: *India, *Annual plants, *Perennial plants.

In arid zones one of the most important vegetation forms is the Therophytes. These are annuals which spring up following a rainy period, move swiftly through their life cycle and survive through the dormant season only in seed form. Therophytes usually form some of the most palatable forage and are likely to be grazed off before mature seeds develop if the arid range is overgrazed. This paper reports a study of floristic changes that occur in range lands on the alluvial plains near Jodhpur, India. The climate of the area is characterized by low rainfall, high temperatures, low humidity and desiccating winds. The monsoons occur during the summer and the growing season of about 90 days follows onset of the rains. Only five perennials were found in the long dry period before the monsoons. During monsoons perennials increase in number of colonies but decrease in number of individuals. Forbs increase rapidly in number but perennial weeds are slow to germinate. Desirable ephemerals do not complete successfully with weed species which compete more successfully with perennials. Five species were found that could behave as annuals or as perennials depending upon environmental conditions. (Crouse-Arizona)
W70-02553

WATER REQUIREMENTS OF LAWNGRASS,
Nevada Agricultural Experiment Station, Reno; and Agricultural Research Service, Amex, Iowa. Soil and Water Conservation Research Div.
For primary bibliographic entry see Field 02D.
W70-02562

EFFECTS OF EXTERNAL SALT CONCENTRATIONS ON WATER RELATIONS IN PLANTS. VI: EFFECTS OF THE EXTERNAL OSMOTIC WATER POTENTIAL ON SOLUTE REQUIREMENT, SALT TRANSPORT KINETICS AND GROWTH RATES OF LEAVES,
California Univ., Riverside. Dept. of Soils and Plant Nutrition.
J. J. Oertli.
Soil Science, Vol 105, No 5, p 302-310, 1968. 12 fig, 9 ref.

Descriptors: *Salts, *Soil-water-plant relationships, *Osmotic pressure, *Plant growth, *Arid lands, Salinity, Plant physiology, Air environment, Soil environment, Environmental effects, Vegetation effects, Leaves, Moisture stress, Turgidity, Solutes, Soil water, Cytological studies, Barley, Kinetics, Xylem, Growth rates, Isotherms.
Identifiers: *Water potential, *Salt transport (Plants).

This is one of a series of reports on effects of salt in soil water on plant-water relations. The experiment measured osmetic potential in the petiole and external solution using a Mechrolab vapor pressure osmometer. Turgor pressure of expanding leaf cells was arbitrarily set at 5 bars. The external solute requirement required to maintain this turgor pressure as water potential varied was measured. The results are presented in graphic form. Different turgor pressures would result in parallel shifts in the curve. Results indicate that solute requirements to maintain turgor pressure in leaves increase in proportion to external water stress. Salt transport through the plant decreases in efficiency with increasing salt accumulations. In elongating cells solute requirements must be met continuously. It follows then that cell expansion and leaf growth should be less at either low or high salt concentrations. The optimum level will be somewhere in the middle. Experimental results with barley seedlings supported this conclusion. It was observed that high atmospheric moisture stress, common in arid lands, decreased growth rates by increasing solute requirements. Growth reduction, even without visible leaf injury caused by salinity, is a result of osmotic relationships. (Crouse-Arizona)
W70-02566

DETERMINATIONS OF LEAF AND FRUIT WATER POTENTIAL WITH A PRESSURE CHAMBER,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Irrigation Research Lab.
Betty Klepper, and R. D. Ceccato.
Horticultural Research, Vol 9, No 1, p 1-7, 1969. 2 plates, 1 fig, 9 ref.

Descriptors: *Plant physiology, *Plant tissues, *Soil-water-plant relationships, *Irrigation efficiency, Horticultural crops, Turgidity, Leaves, Fruit crops, Pressure, Osmotic pressure, Measurement, Instrumentation.
Identifiers: *Water potential, *Pressure chamber, Australia.

The water status of a plant can be measured by its water potential. The water potential of a leaf is the sum of components such as osmotic and matric potential of the cells and pressure potential arising from turgor. All of these affect the chemical potential of leaf water. Research on water status of horticultural plants is particularly important in dry areas since it is valuable in developing guidelines for irrigation practices. The authors report on an experiment conducted in New South Wales, Australia, to test usefulness of a pressure chamber in measuring water potential of both leaves and fruits in horticultural plants. The pressure chamber proved useful and sufficiently accurate for making field measurements of water potential of both leaves and fruit of horticultural crops. The ability to make field measurements of the water status of fruits opens up new possibilities for developing improved irrigation schedules relative to the needs of developing fruit. (Crouse-Arizona)
W70-02568

2J. Erosion and Sedimentation

LINEAR EROSIONAL FURROWS IN SOUTHAMPTON WATER,
Southampton Univ. (England). Dept. of Oceanography.
K. R. Dyer.
Nature, Vol 225, No 5227, p 56-58, Jan 3, 1970. 3 p, 2 fig, 5 ref.

Descriptors: *Erosion, *Esturaries, *Density stratification, *Currents (Water), Streamflow, Tidal effects, Channel morphology, Bed load, Sediment transport, Scour.
Identifiers: *England, Southampton Water.

Linear erosional furrows were found in the bottom of Southampton Water, an estuary on the south coast of England. Transit sonar and echo sounding show the furrows to have a V-shaped cross-section up to 5 m wide and 1 m deep. Individual furrows could be traced for up to 4 km, though bifurcation and interdigitation occurred. They were spaced between 10-25 m apart and each furrow transgressed across the slope into the deeper water towards the mouth of the estuary. The most extensive occurrence of furrows was on the western side of the deep channel. Measurements of current velocity, salinity and temperature at a number of stations at all states of the tide show that Southampton Water is an estuary of moderately stratified type. During the ebb the velocity 1 m from the bottom exceeds 70 cm per sec and the minimum bed shear stress, calculated using the smooth boundary form of the van Karman-Prandtl equation, reaches 6 dynes per sq cm. (Knapp-USGS)
W70-02445

EFFECTS OF UNIT WEIGHT AND SLOPE ON EROSION,
Cornell, Howland, Hayes and Merryfield, Seattle, Wash.; Montana State Univ., Bozeman. Dept. of Civil Engineering; and Montana State Univ., Bozeman. Dept. of Engineering Mechanics.
Richard L. Foster, and Glen L. Martin.
ASCE Proc, J Irrig and Drainage Div, Vol 95, No IR4, Pap 6984, p 551-561, Dec 1969. 11 p, 9 fig, 2 tab, 6 ref, append.

Descriptors: *Erosion, *Soil erosion, *Slopes, *Soil compaction, Drainage, Rainfall, Roads, Rainfall-runoff relationships, Model studies, Laboratory tests, Statistical methods.

Identifiers: Slope-erosion relations.

Laboratory tests were performed on a fine grained soil to determine the effect of unit weight and slope on erosion and runoff. The tests were conducted on slopes of 1:1, 2:1 and 3:1 using unit weights of 80, 85, 90 and 95 lb per cu ft and a simulated rainfall intensity of 6 in. per hr. After collecting the runoff water and solid particles, the weight of solids eroded and the volume of runoff water were determined. The results and analyses of this study indicate that the slope and unit weight have definite effects on the erosion of unprotected slopes. These indications are: (1) On the flattest slope, the specimens compacted to the lowest unit weight experience the highest rate of erosion; (2) on the steepest slope, the specimens compacted to the highest unit weight experience the highest rate of erosion; and (3) for a given unit weight, there is a unique slope from which the maximum amount of erosion will occur. (Knapp-USGS)
W70-02451

FRICTION FACTORS FOR FLOW IN SAND-BED CHANNELS,
Massachusetts Inst. of Tech., Cambridge. Hydrodynamics Lab.; and Iowa Univ., Iowa City. Inst. of Hydraulic Research.
A. M. Z. Alam, and J. F. Kennedy.
ASCE Proc, J Hydraul Div, Vol 95, No HY6, Pap 6900, p 1973-1992, Nov 1969. 20 p, 9 fig, 4 tab, 28 ref, append.

Descriptors: *Fluid friction, *Alluvial channels, *Roughness coefficient, Roughness (Hydraulic), Sands, Open channel flow, Channel morphology, Dimensional analysis, Stage-discharge relations, Sediment transport, Sedimentary structures.
Identifiers: Hydraulic friction factors.

A new predictor is developed for friction factors of flows in sand-bed channels. A dimensional analysis is pursued to obtain the form of the quantities entering the relation between the geometry of the bed features, the flow properties, and the equivalent shear stress due to the form-drag of the ripples, dunes, etc. Theoretical considerations of the bed stability lead to expressions for the length and height of the bed features in terms of the properties of the bed sediment and flow. These are introduced into the expression yielded by the dimensional analysis, and the resulting frictional relation is quantified with field and laboratory data. The graphical relation of Lovera and Kennedy is used to obtain the flat-bed friction factor. The predictor is evaluated using field data not included in preparation of the graphical relation between the bed-form friction factor, Froude number, and relative roughness. The depth-discharge relations predicted are found to be in good agreement with the measured data. (Knapp-USGS)
W70-02461

LOCAL SCOUR AROUND BRIDGE PIERS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-02462

COORDINATION IN MOBILE-BED HYDRAULICS,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-02463

MOVEMENT OF SAND IN TUNNELS,
Norges Tekniske Hoegskole, Trondheim. River and Harbor Lab.
For primary bibliographic entry see Field 08B.
W70-02465

SCALING PROCEDURES FOR MOBILE BED HYDRAULIC MODELS IN TERMS OF SIMILITUDE THEORY,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
John G. Herbertson.
J Hydraul Res, Vol 7, No 3, p 315-353, 1969. 39 p, 5 fig, 5 tab, 47 ref.

Descriptors: *Sediment transport, *Hydraulic similitude, *Hydraulic models, *Model studies, Sedimentation, Hydraulics, Particle shape, Particle size, Laboratory tests, Statistical methods, Open channel flow.
Identifiers: Hydraulic model scale effects, Mobile-bed hydraulic models.

After a brief discussion of the scope of mobile bed hydraulic models and a literature review, a similarity method (the method of synthesis) is outlined, and is used to critically examine the bases of a typical cross-section of the existing scaling techniques for such models. From this examination, it is concluded that there are two types of procedure: (1) those specifying model bed material of the same density as in the prototype; and (2) those specifying light weight materials. Attention is given to the much neglected depth effect parameter (D/H) in the discussion of these procedures. It is thought that complete similarity of sediment transportation in conventional models is impossible. As a consequence, further experimental work under strictly controlled conditions is required to determine which effects are negligible under given circumstances. A procedure derived from the method of synthesis is suggested. In it, hydraulic and sedimentation time scales need not be different. (Knapp-USGS)
W70-02473

LATERAL MIGRATIONS OF THE ARKANSAS RIVER DURING THE QUATERNARY-FOWLER, COLORADO, TO THE COLORADO-KANSAS STATE LINE,
Geological Survey, Denver, Colo.
Joseph A. Sharps.
Geological Survey Research 1969, Professional Paper 650-C, p C66-C70, 1969. 5 p, 1 fig, 2 ref.

Descriptors: *Geomorphology, *Alluvial channels, *Meanders, *Colorado, Quaternary period, Pleistocene epoch, Sedimentation, Flood plains, Rivers, Sediment load, Channels, Discharge (Water), Stream erosion.
Identifiers: Arkansas River, Lateral channel-migration.

Former positions of the Arkansas River between Fowler, Colo., and the Colorado-Kansas State line at given times during the Quaternary have been determined from the positions of terraces cut at those times. Lateral migration of the river during Quaternary time was probably caused by the introduction of a greater volume of sediment into the channel from one side than from the other. Gravel deposited by the Arkansas River differs from tributary gravel in composition and grain size. (Knapp-USGS)
W70-02475

COMPARISON OF WIND WAVE AND UNIFORM WAVE EFFECTS ON A BEACH,
California Univ., Berkeley.
For primary bibliographic entry see Field 02L.
W70-02476

SUSPENDED SEDIMENTS UNDER TURBULENT CONDITIONS (RUSSIAN),
L. N. Kaskevich.
In: Vodnye Resursy i Vodnoe Khozyaistvo Sibiri (Water Resources and Water Economy of Siberia), Akad Nauk SSSR, Sibirskoye Otdelenie, Geogr Obschestvo, Novosibirsk, USSR, p 24-29, 1968. 6 p, 1 fig, 4 ref.

Descriptors: *Suspended load, *Sediment load, *Rivers, *Reservoirs, *Winds, Mathematical studies, Turbulent flow, Velocity, Turbidity, Weight, Sedimentation rates, Streamflow, Waves (Water).
Identifiers: *USSR, Water wave-suspended load relations.

Sedimentation rates and turbidity of suspended loads were analytically investigated. A differential equation of the vertical distribution of suspended load was derived and solved. The mathematical analysis of suspended load characteristics in turbulent waters was compared with the data observed at the Novosibirsk Water Reservoir. Streamflow surface waves lead to the conditions of suspended load saturation and the orbital velocity developed during the vertical redistribution of sediments leads to an increase in the mixing of suspended loads. (Gabriel-USGS)
W70-02481

OOLITIC ARAGONITE AND QUARTZ SAND: LABORATORY COMPARISON UNDER WAVE ACTION,
Army Coastal Engineering Research Center, Washington, D.C.
For primary bibliographic entry see Field 08E.
W70-02624

HYDROGRAPHIC AND SEDIMENTATION SURVEY OF KAJAKAI RESERVOIR, AFGHANISTAN,
Geological Survey of Afghanistan, Kabul. Water Resources Div.
Don Perkins, and James K. Culbertson.
Geol Surv Open-file Rep, Dec 1968. 87 p, 36 fig, 8 tab.

Descriptors: *Dams, *Hydrograph analysis, *Reservoir silting, *Reservoir storage, Sampling, Particle size, Mapping, Sediment discharge, Sediment control, Altitude, Topography, Sedimentation rates, Inflow, River basins
Identifiers: *Afghanistan, Helmond River, Kajakai Reservoir.

This monograph presents the results of a hydrographic and sedimentation survey of Kajakai Reservoir on the Helmond River, Afghanistan, made during the period September through December 1968 for the purpose of defining the current stage-capacity relation and to determine the rate of sedimentation and the sediment range lines. Samples were obtained of the lake bed and in the river upstream from the reservoir. No sediments coarser than about 0.063 millimeter are present on the lake bed surface. The median diameter of sands being transported into the reservoir ranges from 0.040 to 0.110 millimeter. The average annual sedimentation rate is 7,800 acre-feet. Assuming an average density of 800 kg per cubic meter, the estimated average sediment inflow to the reservoir is about 7,700,000 metric tons per year. The decrease in capacity at spillway elevation for the period of 1953 to 1968 due to sediment deposition was 7.8% or 117,700 acre feet. (Gabriel-USGS)
W70-02669

BEDLOAD FORMULAS,
Pennsylvania State Univ., University Park. Coll. of Engineering.
Sam Shulits, and Ralph D. Hill, Jr.
Report available from US Dept of Agriculture, NE Watershed Research Center, Room 111, Research Bldg A, University Park, Pennsylvania, 16802. Pennsylvania State University Hydraulics Laboratory Bulletin, Dec 1968. 212 p, 23 fig, 8 tab, 85 ref.

Descriptors: *Bed load, *Sediment transport, *Equations, *Reviews, Computer programs, Bibliographies, Digital computers, Sediment discharge, Discharge (Water), Tractive forces, Open channel flow.
Identifiers: *Bed load formulas.

Formulas for computing bed load are reviewed, and FORTRAN program listings are given for digital computer solution of 14 of them. The programs are for the formulas of Schoklitsch, Meyer-Peter, Casey, Haywood, Straub, Waterways Experiment Station, Shields, Kalinske, Meyer-Peter and Muller, Eizerman and Frijlink, Laursen, Rottner, and Einstein. Results of the formulas are compared by calculating and plotting sediment discharge against water discharge for all of them. Each formula is presented in its original form and units, and its use is explained as the originator intended. It is concluded that 3 of the formulas give the best results, with adequate agreement with data. The Schoklitsch (1934) formula is selected as the best relation of bed load to discharge. The Straub and the Meyer-Peter and Muller formulas are selected as the best relations of bed load to tractive force. The 3 formulas are valid for effective particle diameters from 0.3 to 7 mm. The Schoklitsch (1934) formula is proposed as the best of the 3 because of its simple form and because it produces directly a bed load-discharge rating curve. (Knapp-USGS)
W70-02671

REVETMENTS FOR BANK PROTECTION USING VERY ROUGH-SURFACED FERRO-CONCRETE ELEMENTS (FRENCH),
Institut d'Amenagement et d'Economie de l'Eau, Warsaw (Poland).
For primary bibliographic entry see Field 08A.
W70-02696

SHORE EROSION AND PROTECTION ST. LAWRENCE RIVER-CANADA,
Department of Public Works (Canada).
For primary bibliographic entry see Field 08A.
W70-02697

HISTORICAL, FIELD AND EXPERIMENTAL STUDIES OF THE SUEZ CANAL BANK PROTECTION,
Suez Canal Authority Research Center, Ismailia (Egypt); and International Commission for Irrigation and Drainage.
For primary bibliographic entry see Field 08A.
W70-02698

METHODS OF BANK PROTECTION FOR PORT, INLAND WATER-WAY AND RIVER,
Toa Harbour Works Co. Ltd., Tokyo (Japan). Engineering Dept.
For primary bibliographic entry see Field 08A.
W70-02699

EROSION PREVENTION EXPERIMENTS,
Connecticut Univ., Storrs.
For primary bibliographic entry see Field 04D.
W70-02730

2K. Chemical Processes

THE MECHANISM OF PHOTOSYNTHESIS,
Harvard Univ., Cambridge, Mass. Biological Labs.
R. P. Levine.
Scientific American, Vol 221, No 6, p 58-70, Dec 1969. 11 fig, 1 photo.

Descriptors: *Photosynthesis, Chlorophyll, Fluorescence, Energy transfer, Light, Phosphates.
Identifiers: Emerson enhancement effect, Chemical processes, Carotenoids, Phycobilins, Cytochromes, NADP, NADPH, ATP, Photochemistry, Chlorophyll a, Chlorophyll b, Chloroplasts, Phycocyanobilin, Hill-Bendall scheme, Mitochondria, Component Q, Ferredoxin reducing substance, Plastocyanin, DCMU, Electron transport.

In a state-of-knowledge review, author summarizes information gaps and current hypotheses on photosynthesis, and important biochemical knowledge bearing on postulated new compounds mediating electron transport in the following sequence: entrapment of light energy, conversion to chemical energy, electron transport, production of NADPH (reduced nicotinamide adenine dinucleotide disphosphate) and ATP (adenoisine triphosphate), and carbon dioxide fixation. New information suggests that two, rather than one, light systems operate in the photosynthetic process used by algae and higher plants. Described as the Emerson enhancement effect, both systems can be driven by light of wavelengths less than 680 manometers; only one, by longer wavelengths. A different species of chlorophyll a is apparently involved in the reaction center of each system. Fluorescence measurements played a key role in developing the hypotheses. Excitation energy is transferred to chlorophyll a by chlorophyll b, the carotenoids and phycobilins. Chlorophyll a cannot be used for photosynthesis, it alone is dissipated as fluorescence. In the initial light system, which remains the least understood, four electrons and four protons are extracted from water with the evolution of a molecule of oxygen. No references, but key scientists and their schools are identified. (Gerhold-Wisconsin)
W70-02503

EFFECT OF YELLOW ORGANIC ACIDS ON IRON AND OTHER METALS IN WATER,
Minnesota Univ., Minneapolis. Limnological Research Center.
Joseph Shapiro.
Journal American Water Works Association, Vol 56, No 8, p 1062-1082, Aug 1964. 11 fig, 5 tab, 29 ref.

Descriptors: *Organic acids, *Iron, *Metals, *Water chemistry, Color, Water quality, Water pollution effects, Lakes, Ionization, Humus, Bogs, Humic acids, Peat, Hydrogen ion concentration, Copper, Manganese, Cobalt, Chelation, New Jersey, Connecticut, New York, Dystrophy.
Identifiers: *Metallic ions, *Organic acids (Yellow), Sphagnum, Zinc, Carboxylic groups, Zoar Lake (Conn), Bantam Lake (Conn), Schulze Hardy rule, East Twin Lake (Conn), Charlotburg Reservoir (NY), Litchfield (Conn), Lake Hopatcong (NJ), Pinecliff Lake (NJ), Lake Musconetcong (NJ), Quassapaug Lake (Conn), Peptization.

By the use of filtration, freezing, amberlite column, hydrochloric acid, and extraction with n-butanol, a 900-liter sample of colored lake water rendered about 2 grams of ash-free yellow acidic substance. In the author's opinion, this material consists primarily of aliphatic polyhydroxy carboxylic acids enriched in nitrogen to 1.2-1.9%. The study of this 'yellow acid' included determination of its molecular weight, iron-retention capacity, chelation and peptization, influence of electrolytes and pH of the medium, and behavior toward copper, manganese, cobalt, and zinc. The results suggested the ionization hypothesis, according to which the initial precipitation of iron or iron-adsorbed yellow acids is followed by peptization when the pH has been raised sufficiently to ionize most of the carboxyl groups. The large quantities of iron held in apparent solution in colored waters may be in the form of a protected colloid; where the ratio of color to iron is high, a part of importance may be played by chelation. (Wilde-Wisconsin)
W70-02505

POLYWATER: PROTON NUCLEAR MAGNETIC RESONANCE SPECTRUM,
Battelle Memorial Inst., Columbus, Ohio; and Maryland Univ., College Park, Dept. of Chemstry.
For primary bibliographic entry see Field 01A.
W70-02618

THERMODYNAMIC MIXING PROPERTIES OF NaCl LIQUIDS,
Harvard Univ., Cambridge, Mass. Dept. of Geological Sciences.
D. R. Waldbaum.
Geochimica et Cosmochimica Acta, Vol 33, No 11, p 1415-1427, Nov 1969. 13 p, 4 fig, 4 tab, 46 ref.

Descriptors: *Geochemistry, *Aqueous solutions, *Thermodynamic behavior, *Liquids, *Potassium compounds, Sodium compounds, Entropy, Energy, Water temperature, Crystallization.
Identifiers: *NaCl-KCl liquids thermodynamics.

The excess Gibbs energies and entropies of mixing of NaCl-KCl liquids have been calculated using previously derived mixing parameters of the crystalline solutions and the temperature and composition of the minimum (657 deg C, 48.5 mole percent KCl) in the melting region. Margules parameters of the liquid based on the present formulation differ by 1 KCl at 800 deg C from the values obtained in electrochemical studies. Solidus and liquidus curves calculated from these results are compared with experimental data from 12 previous studies of the melting region. Alkali buffer potentials, in this system, calculated from the mixing properties of the liquid range from -14.6 plus or minus 0.5 kcal at 796 deg C to -5.90 plus or minus 0.05 kcal at the minimum, to+7.6 plus or minus 0.5 kcal at 770 deg C. (Gabriel-USGS)
W70-02627

GEOCHEMISTRY AND ORIGIN OF FORMATION WATERS IN THE WESTERN CANADA SEDIMENTARY BASIN - I. STABLE ISOTOPES OF HYDROGEN AND OXYGEN,
Research Council of Alberta, Edmonton; and Geological Survey, Denver, Colo.
Brian Hitchon, and Irving Friedman.
Geochimica et Cosmochimica Acta, Vol 33, No 11, p 1321-1349, Nov 1969. 29 p, 8 fig, 7 tab, 45 ref.

Descriptors: *Geochemistry, *Water sources, *Aquifers, *Groundwater, *Sedimentary basins (Geological), Stable isotopes, Hydrogen, Oxygen, Oil fields, Surface waters, Sea water, Deuterium, Statistical methods, Sulfides, Carbonates, Porosity, Shales.
Identifiers: Western Canada basin geochemistry.

Stable isotopes of hydrogen and oxygen, together with chemical analyses, were determined for surface (20 samples), shallow potable formations (8), and oil and gas field waters (79 samples). The observed isotope ratios can be explained by mixing of surface waters and diagenetically modified sea water. Mass balances for deuterium and total dissolved solids in the western Canada sedimentary basin demonstrate that the present distribution of deuterium in the formation waters of the basin can be derived through mixing of the diagenetically modified sea water with fresh water and their subsequent movement through the basin. Statistical analyses of the isotope data indicate an insignificant rate of deuterium exchange between water and hydrogen sulfide and considerable exchange of oxygen isotopes between water and carbonate minerals. (Gabriel-USGS)
W70-02628

PARTICULATE ALUMINUM AND IRON IN SEA WATER OFF THE SOUTHEASTERN COAST OF THE UNITED STATES,
Duke Univ., Beaufort, N.C. Marine Lab.
Larry P. Atkinson, and Unnsteinn Stefansson.
Geochimica et Cosmochimica Acta, Vol 33, No 11, p 1449-1453, Nov 1969. 5 p, 2 fig, 2 tab, 6 ref.

Descriptors: *Geochemistry, *Iron, *Sea water, *Coasts, *United States, Estuaries, Rivers, Salinity, Water chemistry, Continental shelf, Continental slope, Analytical techniques, Mapping, Sampling, Runoff, Seasonal, Chlorides, Clays.
Identifiers: Southeastern coast, Chesapeake Bay, Cape Kennedy.

Sea water samples (39) collected during three cruises of the R/V Eastward in the shelf waters between Chesapeake Bay and Cape Kennedy were analyzed to determine their Al and Fe content. The study indicates that concentrations of particulate iron and aluminum in river and shelf waters of the

eastern United States are indirectly related to salinity but show a loss greater than that from simple mixing. East coast concentrations of particulate iron are less than comparable west coast concentrations. (Gabriel-USGS)
W70-02630

ALKALINITY BUDGET OF THE COLUMBIA RIVER,
Oregon State Univ., Corvallis. Dept. of Oceanography; Federal Water Pollution Control Administration, Washington, D.C. Div. of Engineering Development; and Idaho Univ., Moscow. Dept. of Chemistry.
P. Kilho Park, George R. Webster, and Roy Yamamoto.
Limnology and Oceanography, Vol 14, No 4, p 559-567, July 1969. 9 p, 3 fig, 4 tab, 17 ref. Grants GP-2232, GP-2876, and GP-5317 (NSF) Res Contract Nonr-1286 (10)-ONR.

Descriptors: *Alkalinity, *River flow, *Columbia River, Carbonates, Water chemistry, Dissolved solids, Silicates, Calcium carbonate, Estuaries, River basins, Weathering, Sampling, Mapping, Phosphates, Nitrates, Streamflow, Discharge (Water).
Identifiers: Alkalinity budget.

Columbia River alkalinity essentially consists of carbonate alkalinity (94%) with some silicate alkalinity where dissolved silicate concentration is high. Phosphate and borate contribute insignificantly to the overall alkalinity. The river delivered 11 megatrons of calcium carbonate to the Pacific Ocean during the water year 1963. Regardless of high seasonal flow-rate variance, the river alkalinity near the river mouth shows little variation with an average value of 1 meq/liter. (Gabriel-USGS)
W70-02642

SOLUBILITIES OF NITROGEN, OXYGEN, AND ARGON IN DISTILLED WATER,
Amherst Coll., Mass. Dept. of Physics.
Cornelius E. Klots, and Bruce B. Benson.
Journal of Marine Research, Vol 21, p 48-57, 21, 1, 1963. 1 fig, 4 tab, 21 ref.

Descriptors: *Solubility, *Nitrogen, *Oxygen, *Argon, Temperature.
Identifiers: Bunsen absorption coefficient, Distilled water.

The solubilities of nitrogen, oxygen and argon in distilled water in the temperature range 2-27 deg C have been measured with an estimated accuracy of 0.1%. Both absolute and solubility ratio techniques were employed. Tabulations are present of the Bunsen absorption coefficients and Henry's law constants for nitrogen, oxygen and argon and the ratio of the absorption coefficients to those for nitrogen. The solubilities found by Fox, Winkler, Hamberg and others are compared. It is concluded that the values of oxygen solubility in Standard Methods are high except at the lowest temperatures, and the values of the ASCE research committee are slightly low above 15 deg C. (Rietveld-Vanderbilt)
W70-02701

SOLUBILITY OF ATMOSPHERIC OXYGEN IN WATER,
Harvard Univ., Cambridge, Mass. Sanitary Engineering Div.
J. Carrell Morris, Werner Stumm, and Hend A. Galal.
Journal of the Sanitary Engineering Division, Proceed of ASCE, Vol 87, SA 1, p 81-86, Jan 1961. 2 fig, 2 tab.

Descriptors: *Solubility, *Dissolved oxygen, Temperature, Saturation.
Identifiers: Winkler method, Bunsen absorption coefficient, Distilled water.

The apparatus for obtaining saturation of water with air at constant pressure and the apparatus for manometric determination of oxygen solubility are described in some detail. Two tables give the saturation values for oxygen in water as obtained by the above mentioned equipment. The data obtained by the TVA group are in concordance with this data, however, two facts are missing in the description of the Elmore and Hayes study: (1) if the air being equilibrated with water was saturated with water vapor, (2) no mention of correction of barometric prressures to standard conditions. This article is only a prediscussion of a more complete study for the USPHS. (Rietveld-Vanderbilt)
W70-02702

DETERMINATION OF DISSOLVED OXYGEN BY THE WINKLER METHOD AND THE SOLUBILITY OF OXYGEN IN PURE WATER AND SEA WATER,
Water Pollution Research Lab., Stevenage (England).
H. A. C. Montgomery, N. S. Thom, and A. Cockburn.
Journal of Applied Chemistry, Vol 14, p 280-296, July 1964. 4 fig, 11 tab, 65 ref.

Descriptors: *Solubility, *Dissolved oxygen, Seawater, Temperature.
Identifiers: Winkler method, Adeney-Becker law, Distilled water.

Values for the solubility of oxygen in water obtained by a modification of the Winkler method are shown to be low because of losses of iodine vapor. Iodine vapor is also lost in two of the standard modifications of the Winkler method in common use, the amount lost depending on the technique of the analyst. The volatilization of iodine can be avoided by the use of the alkaline iodide reagent of Pomeroy and Kirschman; a procedure employing this reagent is described. Interference by nitrites and ferric iron may be eliminated by sodium azide and phosphoric acid respectively. The accuracy of the Winkler method, modified to prevent the loss of iodine vapor, has been confirmed using gaseous oxygen as a standard. Using the procedure recommended, determinations have been made of the solubility of atmospheric oxygen in distilled water between 0.4 deg and 37 deg, and in sea water between 2 deg and 27 deg. The results for distilled water are in excellent agreement with those of Klots and Benson between 2 deg and 27 deg; the new values for sea water agree fairly well with those of Fox. The values in Standard Methods are shown to be high, except at the lowest temperatures, and the values of the ASCE research committee to be low above 15 deg C. In measurements of the rate of solution of oxygen, the approach to equilibrium using these values was consistent with the law of Adeney and Becker. This article contains 65 references. (Rietveld-Vanderbilt)
W70-02705

NEW MEASUREMENTS OF OXYGEN SOLUBILITY IN PURE AND NATURAL WATER,
Johns Hopkins Univ., Baltimore, Md. Dept. of Oceanography.
James H. Carpenter.
Limnol Oceanogr, Vol 11, p 264-277, 1966. 5 fig, 5 tab, 29 ref.

Descriptors: *Solubility, *Dissolved oxygen, *Temperature, *Chlorides, Seawater.
Identifiers: *Chlorinity, Titrimetric method, Gasometric method, Winkler method, Distilled water.

The measurements of oxygen solubility in distilled water and dilutions of seawater were made with the Winkler titrimetric method after an extended study of its errors. The system and instruments used are described. The measurements were made over the temperature range 0.5 deg to 35 deg C. Nonlinear dependence of oxygen solubility on chlorinity was found. Interpolation tables of the data have been prepared. The accuracy of the techniques was approximately 0.1%, so the tables appear to be more reliable than those in current use. Because many of the existing field data have been collected using techniques for the Winkler method that introduce significant systematic errors due to volatilization and air oxidation errors, the use of the reported solubility values with these field data will produce misleading results. The values determined agree well with the values of Klots and Benson, and with those of Montgomery, Thom, and Cockburn. This article contains 21 references. (Rietveld-Vanderbilt)
W70-02712

A FLUOROMETRIC METHOD FOR DETERMINING TRACE QUANTITIES OF FLUORIDE,
Missouri Univ., Columbia. Dept. of Chemistry.
For primary bibliographic entry see Field 07B.
W70-02726

A FLUOROMETRIC DETERMINATION OF IODIDE ION,
Missouri Univ., Columbia. Dept. of Chemistry.
For primary bibliographic entry see Field 07B.
W70-02727

FLUOROMETRIC DETERMINATION OF OXALATE ION,
Missouri Univ., Columbia. Dept. of Chemistry.
For primary bibliographic entry see Field 07B.
W70-02728

CHEMISTRY OF THE OXIDANT, FERRATE, ITS INTERACTION WITH SPECIFIC ORGANICS FOUND IN WASTE WATER,
Kentucky Water Resources Inst., Lexington.
For primary bibliographic entry see Field 05G.
W70-02738

THE DETERMINATION OF THE ENGINEERING THERMO-PHYSICAL PROPERTIES OF SOLUTIONS CONTAINING DISSOLVED SOLIDS,
Connecticut Univ., Storrs. Inst. of Water Resources.
David A. Fisher, and James G. Daley.
Research Project Technical Completion Report, Nov 1970. 4 p, 7 tab. OWRR Project A-010-CONN.

Descriptors: *Seawater, *Enthalpy, *Entropy, *Specific heat.

The value of enthalpy of seawater concentrates above their value at 0 deg C has been determined in the temperature range 0 deg C to 200 deg C based on measurements made of the heat given off by samples of seawater when cooling, from some temperature to 0 deg C. These concentrates ranged from a salinity of 1% to 28%. From this data a polynomial expression for enthalpy has been determined which, together with other thermodynamic considerations, permits the evaluation of specific heat and entropy in this range of temperature and concentration. Tables have been prepared giving enthalpy, entropy and specific heat in this range for which the values of enthalpy and entropy at 0 deg C are based on the heat of mixing of sodium chloride solutions of equivalent dissolved solids.
W70-02749

AN INVESTIGATION OF THE STRUCTURAL CHEMISTRY OF YELLOW ORGANIC MATTER IN FRESH WATER,
Rhode Island Univ., Kingston. Dept. of Agricultural Chemistry.
George T. Felbeck, Jr.
Technical Completion Report, Rhode Island Water Resources Center, 1969. 6 p. OWRR Project A-018-RI.

Descriptors: *Yellow organic matter, *Humic acid, *Bacteria, *Fungi, *Fresh water, *Aquatic microflora.

Colonies of aquatic microflora were isolated from samples of highly colored pond water. From the large number of bacteria and fungi isolated on agar plates only a very few produced yellow-colored exudates when grown in a submerged culture. None of the pigments produced in this fashion were water soluble. The only yellow-colored water soluble materials that were obtained occurred in cultures of fungi grown under non-agitated conditions and with the presence of aerial mycelia. Therefore, these results are consistent with previous chemical evidence that the yellow-colored organic matter in fresh water is derived either directly from soil fungal products or indirectly through the breakdown of the soil humic acid polymers.
W70-02769

2L. Estuaries

COMPARISON OF WIND WAVE AND UNIFORM WAVE EFFECTS ON A BEACH,
California Univ., Berkeley.
Peter Truman Kraai.
Shore and Beach, Vol 37, No 2, p 60-71, Oct 1969. 12 p, 19 fig, 1 tab, 18 ref.

Descriptors: *Waves (Water), *Beaches, *Sediment transport, *Model studies, Sands, Beach erosion, Bed load, Winds, Profiles, Ocean waves, Currents (Water), Deposition (Sediments), Littoral drift, Shores, Surf.
Identifiers: *Beach erosion models, Wave-making machines.

A series of two dimensional experiments were made in a wave channel to compare the nearshore beach profiles formed by wind-generated waves with the profiles formed by periodic machine-generated waves. Although equilibrium was easily obtained in the case of uniform periodic wave exposure, it was not possible to achieve equilibrium when the beach was exposed to wind waves. The basic current systems differed in the offshore zone for the two cases. No theoretical equilibrium beach profile exists for the case of a beach exposed to locally generated wind waves. The basic mechanism for the movement of sand seaward during the winter season is the offshore bottom current which is a result of the wind setup experienced during intense local storms in the winter. (Knapp-USGS)
W70-02476

SALT-WATER ENCROACHMENT INTO AQUIFERS.

Proceedings of Symp held at Louisiana State Univ, Baton Rouge, May 4-5, 1967. Louisiana Water Resources Research Institute Bulletin 3, Louisiana State University, Oct 1968. 192 p, 38 fig, 15 tab, 91 ref. OWRR Proj No A-004-LA.

Descriptors: *Saline water intrusion, *Aquifers, Hydrogeology, Water management (Applied), New York, Florida, California, Groundwater movement, Surface-grownd water relationships, Water law, Legal aspects, Drainage, Withdrawal, Administrative agencies.
Identifiers: Aquifer management.

A symposium record contains discussions of salt water encroachment into aquifers in Florida, New York and California, Management of aquifers, encroachment control, hydrogeology, and legal aspects of encroachment. Each discussion consists of a paper presented as a preprint, a short introductory statement by the author, and discussion by the symposium participants. (See also W70-02485 thru W70-02492). (Knapp-USGS)
W70-02484

COMBATING SALT-WATER ENCROACHMENT INTO THE BISCAYNE AQUIFER OF MIAMI, FLORIDA,
Dade County Engineering Dept., Miami, Fla.
F. D. R. Park
Louisiana Water Resources Research Institute Bulletin 3, Louisiana State University, p 31-56, Oct 1968. 26 p, 14 fig, 2 tab, 16 ref. OWRR Proj No A-004-LA.

Descriptors: *Saline water intrusion, *Aquifers, *Florida, *Water management (Applied), Legal aspects, Water law, Water conservation, Land management, Drainage, Withdrawal, Administrative agencies.
Identifiers: Water quality management.

Urbanization of Dade Co., Florida and attempts to drain the Everglades have lowered the water table. During periods of drought, the current withdrawal rate of fresh water allows salt-water intrusion. Recharge from rainfall periodically pushes salt water to the sea. It is desirable to artificially hold a high water level to offset intrusion during droughts. Salinity dams, prevention of further primary drainage, and navigation channels are used in salinity control. Little opposition has been encountered in enforcement of the salt barrier line on private lands. The main enforcement difficulties are caused by the Public Works and Mosquito Control Units. Court decisions subordinate riparian rights to the public need of an uncontaminated fresh water supply. Lesser pollution problems arise from industrial and domestic discharges. An effective answer lies in county-wide sewage collection and disposal. (See W70-02484). (Knapp-USGS)
W70-02485

SALT-WATER INTRUSION IN SOUTHEASTERN FLORIDA,
Central and Southern Florida Flood Control District, West Palm Beach, Fla.
Robert Grafton.
Louisiana Water Resources Research Institute Bulletin 3, Louisiana State University, p 15-30, Oct 1968. 16 p, 1 fig. OWRR Proj No A-004-LA.

Descriptors: *Saline water intrusion, *Aquifers, *Florida, *Water management (Applied), Aquifers, Hydrogeology, Surface-grownd water relationships, Water law, Legal aspects, Water conservation, Land management, Drainage, Withdrawal, Administrative agencies.
Identifiers: Water quality management.

Overdrainage as a result of urbanization and geological conditions resulted in salt-water intrusion into southeastern Florida. After massive flood damage in 1957 and 1958, the Central and Southern Florida Flood Control District was established to acquire lands, represent local interests, raise funds, and operate projects in cooperation with the Federal Government to promote flood control and water preservation. Further legislation is required to broaden the scope of the F.C. D., especially in salt-water intrusion. With the exception of Dade and Broward Counties, little is being accomplished by counties under the guidance of the State Board of Conservation, Department of Water Resources. Increased population is endangering lands committed to conservation areas. However, activities by special agencies against salt-water intrusion in southeastern Florida continue to gain momentum. (See W70-02484). (Knapp-USGS)
W70-02486

PLANNING AND PROVIDING AN ADEQUATE SUPPLY OF WATER FOR ORANGE COUNTY, CALIFORNIA,
Orange County Water District, Santa Ana, Calif.
Howard W. Crooke.
Louisiana Water Resources Research Institute Bulletin 3, Louisiana State University, p 89-103, Oct 1968. 15 p, 2 tab. OWRR Proj No A-004-LA.

Descriptors: *Water management (Applied), *Saline water intrusion, *Aquifers, *California, *Artificial recharge, Pit recharge, Water spreading, Injection wells, Water law, Legal aspects, Overdraft, Taxes.
Identifiers: *Water quality management, *Orange County (Calif).

In the past 17 years, the Orange County Water District of California has purchased more than 1.7 million acre-feet of water to recharge and replenish the Orange County groundwater basin. This water, which was brought 300 miles from the Colorado River, cost $22.5 million. About one-third of this was financed from advalorem taxes levied on all real property within the District; two-thirds was financed from replenishment assessments levied on all water produced from the groundwater supply and paid by those who pumped the water. This extensive replenishment is an integral part of a groundwater management program geared to meet the water needs of an area that has experienced an unprecedented and continuing economic boom. (See W70-02484). (Knapp-USGS)
W70-02487

PROTECTING LONG ISLAND AQUIFERS AGAINST SALT-WATER INTRUSION,
New York State Dept. of Conservation, Albany. Div. of Water Resources.
Francis W. Montanari, and Walter G. Waterman.
Louisiana Water Resources Research Institute Bulletin 3, Louisiana State University, p 59-87, Oct 1968. 29 p, 9 fig, 2 tab, 26 ref. OWRR Proj No A-004-LA.

Descriptors: *Saline water intrusion, *Aquifers, *New York, *Water management (Applied), *Artificial recharge, Saline water-freshwater interfaces, Reclaimed water, Water law, Legislation, Legal aspects, Hydrogeology, Desalination.
Identifiers: Water quality management.

Salt water intrusion in New York involves only the perimeter of Long Island. The problem is compounded by direct contact between the aquifers and the ocean. All Long Island groundwater comes from infiltration with approximately 50% absorption into the aquifers. Since 1933, legislation has been enacted to regulate the groundwater extraction and to license well drillers. The main causes of salt-water intrusion are overpumpage and a reduction in availability of recharge water as a result of urbanization. Projects undertaken to relieve overpumpage are: (1) reservoirs to collect surface water, (2) acquiring pumping rights of sparsely populated areas, and (3) construction of a desalination plant. Plans are under way to salvage 97 mgd of presently wasted sewage water for injection. Presently Long Island is using 15 acres of recharge basins with a capacity of 57 million gallons. Present efforts, such as recharging, are being offset by wasteful sewage discharge. (See W70-02484). (Knapp-USGS)
W70-02488

THE CHALLENGE OF WATER MANAGEMENT: ORANGE COUNTY WATER DISTRICT, CALIFORNIA,
Orange County Water District, Santa Ana, Calif.
Langdon W. Owen.
Louisiana Water Resources Research Institute Bulletin 3, Louisiana State University, p 105-125, Oct 1968. 21 p, 5 fig, 2 tab. OWRR Proj No A-004-LA.

Descriptors: *Water management (Applied), *Saline water intrusion, *Aquifers, *California, *Injection wells, Artificial recharge, Observation wells, Water reuse, Reclaimed water, Groundwater barriers, Water quality.
Identifiers: *Water quality management, *Orange County (Calif).

The technical aspects of effective basin management of Orange County, California water supplies are described. Reliance has been placed on both surface water and groundwater to meet county needs. Surface water is obtained from the Colorado and Santa Ana Rivers and direct precipitation. Groundwater comes from the South Coastal Basin. Feasible use of these sources is dependent on safe withdrawal of large volumes of groundwater during periods of surface water shortage and the ability to sink large quantities of water into the basin when surplus surface water is available. Salt-water intrusion will be controlled by a hydraulic barrier of in-

jection wells. The major problem encountered in injecting reclaimed and surface water is the quality of the available water. Blending of surface water and groundwater provides a desirable composite water source. Computer models have greatly facilitated working knowledge of the groundwater basin operation. (See W70-02484). (Knapp-USGS)
W70-02489

THE HYDROGEOLOGIC SETTING IN LOS ANGELES COUNTY, CALIFORNIA,
Los Angeles County Flood Control District, Calif., Water Conservation Div.
Clinton Milne.
Louisiana Water Resources Research Institute Bulletin 3, Louisiana State University, p 127-151, Oct 1968. 25 p, 8 fig, 7 tab, 11 ref. OWRR Proj No A-004-LA.

Descriptors: *Hydrogeology, *Saline water intrusion, *Aquifers, *California, *Artificial recharge, Water management (Applied), Geology, Injection wells, Drawdown, Water resources development.
Identifiers: *Water quality management, Aquifer management, Los Angeles County (Calif).

Over 80% of the water levels in the principal aquifers underlying the 470-square mile coastal plain area of Los Angeles County, California are below sea level. As a result, aquifers of Pleistocene age, situated at depths down to 750 feet in the critical areas, have been intruded by sea water. The volume of this intrusion is estimated to be 700,000 acre feet. Artificial replenishment is accomplished by the spreading of local storm runoff and the injection of both imported Colorado River water and reclaimed water. Management of grownd water basins will maintain below sea level the water tables underlying most of the coastal plain. Sea-water intrusion will be prevented by the injection of fresh water, which will also provide a major portion of the groundwater replenishment. (See W70-02484). (Knapp-USGS)
W70-02490

THE AMELIORATION OR PREVENTION OF SALT-WATER INTRUSION IN AQUIFERS - EXPERIENCE IN LOS ANGELES COUNTY, CALIFORNIA,
Los Angeles County Flood Control District, Calif.
Arthur E. Bruington.
Louisiana Water Resources Research Institute Bulletin 3, Louisiana State University, p 153-168, Oct 1968. 16 p, 1 fig, 8 ref. OWRR Proj No A-004-LA.

Descriptors: *Water management (Applied), *Saline water intrusion, *Injection wells, *California, Groundwater barriers, Artificial recharge, Aquifers, Water reuse, Construction costs, Operating costs.
Identifiers: *Water quality management, *Los Angeles County (Calif).

Underground storage from winter storms is used in Los Angeles County, California with the pressure-ridge method for recharge of the aquifers for deterring saline intrusion. A line of injection wells create a pressure field much like a continuous curtain wall. Waterlogging has been controlled in low areas by seaward extraction along with pressure-ridge injection. Injected water must be of high quality to prevent clogging of wells, increase well life, and reduce well-cleaning costs. Observation wells are needed at critical points along the barrier line to monitor the groundwater elevation. The location of the barrier line has allowed a certain amount of salt water to be cut off, or trapped behind the barrier. The cost of injected water for 1966, $13.00 per acre-foot did not include the cost of supply water, amortized capital outlay per well, pipelines, and other appurtenances. The uncompleted pressure-ridge system is working as planned. (See W70-02484). (Knapp-USGS)
W70-02491

LEGAL AND ECONOMIC ASPECTS OF SALT-WATER ENCROACHMENT INTO COASTAL AQUIFERS,
Bookman and Edmonston, Glendale, Calif.
Max Bookman.
Louisiana Water Resources Research Institute Bulletin 3, Louisiana State University, p 169-192, Oct 1968. 24 p, 30 ref. OWRR Proj No A-004-LA.

Descriptors: *Saline water intrusion, *Aquifers, *Water management (Applied), *California, *Legal aspects, Costs, Economics, Administrative agencies, Flood control, Artificial recharge, Water reuse, Water rights, Water law.
Identifiers: Water quality management, Los Angeles County (Calif).

An integral part of salt-water intrusion prevention is control and reduction of groundwater production, which, in Los Angeles County, California, required court action. Legislative action was also necessary to empower local water districts to construct, operate, and finance salt-water prevention facilities. At present, 70% of the water is imported. Implementation of controls was a 3-step process: (1) sharing of imported river water with upstream owners; (2) injunctions against Coastal and Central basin pumpers; and (3), establishment of a salt-water barrier. Barrier financing came through advalorem taxes and district general funds. Other legislation provided for financing enforcement. Salt-water prevention in the West Coast basin is administered by 6 state and local agencies and one citizens' association. This arrangement has proved successful and economical. The control of pumping and reduction of groundwater use by pricing is not sufficient to halt salt-water intrusion. Court actions and their consequences are an important economic factor. (See W70-02484). (Knapp-USGS)
W70-02492

THE TRANSFORMATION OF A SOLITARY WAVE OVER AN UNEVEN BOTTOM,
Massachusetts Inst. of Tech., Cambridge. Hydrodynamics Lab.
O. S. Madsen, and C. C. Mei.
Journal of Fluid Mechanics, Vol 39, Part 4, p 781-791, Dec 1969. 11 p, 7 fig, 3 tab, 19 ref.

Descriptors: *Waves (Water), *Mathematical models, *Hydraulic models, Numerical analysis, Mathematical studies, Frequency, Energy, Beaches, Continental shelf.
Identifiers: Wave transformation.

Based on a set of approximate equations for long waves over an uneven bottom, numerical results show that as a solitary wave climbs a slope the rate of amplitude increase depends on the initial amplitude as well as on the slope. Results are also obtained for a solitary wave progressing over a slope onto a shelf. On the shelf a disintegration of the initial wave into a train of solitary waves of decreasing amplitude is found. Experimental evidence is also presented. (Knapp-USGS)
W70-02625

GRAVITY WAVES OVER A NON-UNIFORM FLOW,
Technische Hogeschool Twente, Enschede (Netherlands).
H. G. M. Velthuizen, and L. Van Wijngaarden.
Journal of Fluid Mechanics, Vol 39, Part 4, p 817-829, Dec 1969. 13 p, 5 fig, 8 ref, append.

Descriptors: *Waves (Water), *Mathematical models, Mathematical studies, Numerical analysis, Viscous flow, Hydraulics, Energy, Equations, Boundary layers, Critical flow, Non-uniform flow.
Identifiers: Viscous hydrodynamics.

Propagation of small amplitude gravity waves over a flow with non-uniform velocity distribution is analysed. Viscous effects which are the cause of damping or growth are important in the wall layer near the bottom and also at the critical depth, which is present when the wave speed is between zero and the fluid velocity at the free surface. The basic equations for the problem are given. Exchange of momentum and energy between wave and primary flow is discussed. Illustrations of the theory are given for long waves over running flow and for the flow along a ship advancing in a wavy sea. In these examples a negative curvature of the mean velocity profile is shown to have a stabilizing effect. (Knapp-USGS)
W70-02626

PARTICULATE ALUMINUM AND IRON IN SEA WATER OFF THE SOUTHEASTERN COAST OF THE UNITED STATES,
Duke Univ., Beaufort, N.C. Marine Lab.
For primary bibliographic entry see Field 02K.
W70-02630

TEMPERATURE FLUCTUATIONS SPECTRA IN THE SEA SURFACE LAYER (RUSSIAN),
S. I. Krylov.
English summary. Izvestiya Akademii Nauk, SSSR, Seriya Fiziki Atmosfery i Okeana, Vol 5, No 9, p 921-928, Sept 1969. 5 fig, 2 tab, 4 ref.

Descriptors: *Water temperature, *Fluctuation, *Sea water, *Estuaries, Instrumentation, Air temperature, Mathematical studies, Temperature.
Identifiers: *Baltic Sea, *Water temperature fluctuations.

Temperature fluctuations in sea surface layers were investigated using temperature data recorded in the Baltic Sea, 1963-1967. Temperature fluctuations are characterized by the periods of 2 to 4 min, with temperature differences up to 2.0-2.5 deg C in 3.0 to 3.5-minute periods. (Gabriel-USGS)
W70-02647

A FALLING-PARTICLE CURRENT METER,
Columbia Univ., Dobbs Ferry, N.Y. Hudson Labs.
For primary bibliographic entry see Field 07B.
W70-02670

DISCHARGE OF SEWAGE EFFLUENT FROM A LINE SOURCE INTO A STRATIFIED OCEAN,
California Inst. of Tech., Pasadena. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05D.
W70-02714

CURRENT STUDY IN THE NEUSE RIVER AND ESTUARY OF NORTH CAROLINA,
North Carolina Univ., Morehead City. Inst of Marine Sciences.
William J. Woods.
Available from the Clearinghouse as PB-188 905, $3.00 in paper copy, $0.65 in microfiche. Report No 13, Water Resources Research Institute of the University of North Carolina, Dec 1969. 35 p, 4 tab, 17 fig, 10 ref. OWRR Project A-020-NC.

Descriptors: *Estuaries, *Currents, Inflow, Streamflow.
Identifiers: *Neuse river, Current study, *Tidal prism.

Two Rhodamine B dye insertions were made in the lower 59 km of the Neuse River Estuary during the summer of 1967. Movement of the dye was followed with Turner Model 111 Fluorometers. Time-of-travel estimates of the dye patch were made for the two insertions. Under meteorological conditions existing at the time of the study a mean flushing time of six days and a maximum flushing time of 7.4 days is estimated for the lower 28.2 km of the Neuse River Estuary. A mean flushing time of 12.3 days and a maximum flushing time of 19.25 days is estimated for the 30.8 km of the river immediately below New Bern, North Carolina. A maximum flushing time of 26 to 27 days is estimated for the lower 59 km of the Neuse River Estuary for conditions existing during the summer of 1967. Further measurements are suggested. (Howells-Univ of North Carolina)

W70-02760

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

VALUE OF DESALTED WATER FOR IRRIGATION,
Bureau of Reclamation, Denver, Colo.; and Bureau of Reclamation, Boulder City, Nev.
For primary bibliographic entry see Field 03C.
W70-02632

STUDY OF A DESIGN-OPTIMIZATION PROCEDURE FOR ION-EXCHANGE AND ADSORPTION COLUMNS,
California Univ., Berkeley.
S. Pancharatnam, G. Klein, and T. Vermeulen.
Available from the Superintendent of Documents, US Government Printing Office, Wash DC, 20402, for $1.25 per copy. Office of Saline Water Research and Development Progress Report No 477, Sept 1969. 113 p. OSW Grant 14-1-0001-1698.

Descriptors: *Desalination process, *Ion-exchange, *Sorption.
Identifiers: *Sorption processes, *Fixed-bed, *Regeneration cycle, Process-design.

Optimal design of large-scale ion-exchange systems involves predictions of the effluence concentration under repeated cycles of incomplete exhaustion-regeneration. This report describes the exploratory study of a way to make such predictions, and of their use in optimization procedures. Controllable variables for a specified process are column dimensions, flow rates and running times which give rise to dimensionless length-time values. Output results are the recoveries and purities of desired components in effluent fractions and consequent cost functions. Graphs prepared as described in this report determine how optimally to design or operate a column. A computer program is described which utilizes a 'ridge-climbing' technique to find the economically optimum design. Input to the program includes cost factors for resin, regenerant, apparatus, and power, and correlation constants obtained from a mass-transfer model of the system. Output comprises the optimum combination of bed height and exhaustion flow rate. (Filban-Office of Saline Water)
W70-02687

AXIAL-DISPERSION CONSTANT-PATTERN KINETICS OF ION-EXCHANGE AND ADSORPTION COLUMNS,
California Univ., Berkeley.
Robert E. Quilici, and Theodore Vermeulen.
Available from the Superintendent of Documents, US Government Printing Office, Wash DC, 20402, for $1.00 per copy. Office of Saline Water Research and Development Progress Report No 476, Sept 1969. 95 p. OSW Grant 14-01-0001-1698.

Descriptors: *Desalination process, *Ion-exchange, *Adsorption.
Identifiers: *Adsorption processes, *Fixed-bed separation, Process design.

Engineering design of ion-exchange and adsorption columns for large-scale use has been hindered by the absence of precalculated breakthrough curves of a general nature, which should be available for rapid calculation of practical systems. As an adjunct to research on multicomponent ion exchange sponsored by the Office of Saline Water, attention is being given at the University of California to certain unsolved problems in two-component ion exchange and one-component adsorption in which the solutions are still needed for engineering purposes. Among such problems is the effect of 'longitudinal mixing' or 'axial dispersion' in beds of packed spheres. At low flow rates or with large sorbent particles, axial dispersion may produce a spreading of the concentration breakthrough curves for fixed-bed separations in addition to the spreading given by the mass-transfer resistance alone. The combined effects of axial dispersion and mass transfer have been studied for four controlling exchange mechanisms or models -- external mass transfer, solid diffusion, pore diffusion, and reaction kinetics. Tabulated results of numerical solutions are given for the constant-pattern case, involving constant separation factors from r= 0 to r= 0.7, for dispersion/mass-transfer ratios beta from near zero to 10. (Filban-OFFice of Saline Water)
W70-02688

SALT WATER CORROSION CONTROL BY ENVIRONMENT MODIFICATION,
Dow Chemical Co., Freeport, Tex. Texas Div.
For primary bibliographic entry see Field 08G.
W70-02689

ULTRASONIC DETECTION OF CALCIUM SULFATE SCALE ON METAL SURFACES,
Midwest Research Inst., Kansas City, Mo.
For primary bibliographic entry see Field 08G.
W70-02690

SEA WATER CORROSION TEST PROGRAM,
Dow Chemical Company, Freeport, Tex.
For primary bibliographic entry see Field 08G.
W70-02691

EFFECT OF SURFACE POTENTIAL ON SCALE FORMATION,
TRW Systems Group, Redondo Beach, Calif.
For primary bibliographic entry see Field 08G.
W70-02692

DEVELOPMENT OF A LOW-COST IRON-BASE ALLOY TO RESIST CORROSION IN HOT SEA WATER,
Westinghouse Electric Corp., Pittsburgh, Pa.
For primary bibliographic entry see Field 08G.
W70-02693

PLANNING FOR POWER - A LOOK AT TOMORROWS STATION SIZES,
Ebasco Services, Inc.
For primary bibliographic entry see Field 08C.
W70-02740

EVALUATION OF TITANIUM-PLATED STEEL IN A CHLORIDE ENVIRONMENT,
Solar, San Diego, Calif.
For primary bibliographic entry see Field 08G.
W70-02741

DEVELOPMENT OF A LOW-COST IRON-BASE ALLOY TO RESIST CORROSION IN HOT SEA WATER,
Westinghouse Electric Corp., Pittsburgh, Pa.
For primary bibliographic entry see Field 08G.
W70-02742

THE DETERMINATION OF THE ENGINEERING THERMO-PHYSICAL PROPERTIES OF SOLUTIONS CONTAINING DISSOLVED SOLIDS,
Connecticut Univ., Storrs. Inst. of Water Resources.
For primary bibliographic entry see Field 02K.
W70-02749

3B. Water Yield Improvement

DESERTS; THE PROBLEM OF WATER IN ARID LANDS,
London Univ. (England). Inst. of Education.
For primary bibliographic entry see Field 02A
W70-02561

SUITABILITY OF THE UPPER COLORADO RIVER BASIN FOR PRECIPITATION MANAGEMENT,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
Hiroshi Nakamichi, and Hubert J. Morel-Seytoux.
Colorado State University Hydrology Paper No 36, Oct 1969. 62 p, 12 fig, 8 tab, 58 ref, 2 append. Contract No BR 14-06-D-6597 (Bur of Reclam).

Descriptors: *Precipitation (Atmospheric), *Management, *Colorado River Basin, *Cloud seeding, Demonstration watersheds, Research and development, Statistical methods, Hydrologic aspects, Runoff forecasting, Hydrograph analysis, Seasonal.
Identifiers: *Precipitation management, Pilot program, Suitability criteria, Upper Colorado Basin.

Watershed suitability for weather modification over the entire Upper Colorado River Basin is discussed from the hydrologic standpoint. Determination of watershed or groups of watersheds for precipitation management programs was a primary objective of the study, particularly in the San Juan Mountains and the upper part of the Colorado basin. A relationship between precipitation and spring runoff with greater than 0.90 correlation coefficient was obtained for 365 sets of gaged subbasins by applying a multiple linear regression analysis, the independent variables being winter and spring precipitation. Assuming a uniform 10% increase in winter precipitation on the upper Colorado River basin, calculations show that three years of operations are needed for evaluation in that basin versus six years in the San Juan Mountains. (Lang-USGS)
W70-02622

WATER IN THE KAHUKU AREA, OAHU, HAWAII,
Geological Survey, Washington, D.C.
K. J. Takasaki, and Santos Valenciano.
Geol Surv Water-Supply Paper 1874, 1969. 59 p, 29 fig, 1 plate, 7 tab, 21 ref.

Descriptors: *Water resources, *Groundwater, *Surface waters, *Hawaii, Aquifers, Basalts, Water levels, Water wells, Hydrogeology, Hydrologic data, Data collections, Water quality, Water yield, Streamflow, Springs, Infiltration, Rainfall, Climates, Topography.
Identifiers: *Kahuku (Hawaii), Oahu.

The Kahuku area of Oahu, Hawaii comprises the north end of the Koolau Range and its bordering coastal plain. A 2 1/2-mile-wide dike zone of parallel and subparallel dikes along the crest is the remnant of the fissure zone of eruption. Outcrops are mostly permeable lava flows of the Koolau Volcanic Series, which are intruded by dikes inside the dike zone and are free of dikes outside it. The lava flows constitute main aquifers, and water bodies in them are called dike water inside the dike zone and basal water outside it. Basal water occurs on either side of the dike zone. The quality of dike water is excellent except near the north end, where it is slightly contaminated by infiltration of irrigation water that contains as much as 1,200 mg/l chloride. The major contaminant, however, is sea water. In the Kahuku subarea--where pumpage from the basal-water body is greatest--sea-water contamination is a major concern. Natural contamination by encroaching sea water extends more than 2 miles inland in the Waimea-Kawela subarea and generally precludes development of large quantities of basal water. At low altitudes where the perennial flow is small, all streams are intermittent

except Kaluanui and Kamananui. Streamflow cannot be economically developed and is not a reliable source of water supply. Average rainfall is about 240 mgd. Groundwater flow is estimated to be 85 mgd. The most promising areas for developing basal water are in the Hauula and Laie subareas. The development of dike water is promising in the Waimea-Kawela subarea. (Knapp-USGS)
W70-02623

RATE AND DIRECTION OF GROUNDWATER CIRCULATION IN CLOSE SPACED BEDROCK AND GRAVEL WELLS UNDER NON-SYNCHRONOUS PUMPING TIME AND RATES,
Connecticut Univ., Storrs. Inst. of Water Resources.
For primary bibliographic entry see Field 04B.
W70-02735

3C. Use of Water of Impaired Quality

SALT-WATER ENCROACHMENT INTO AQUIFERS.
For primary bibliographic entry see Field 02L.
W70-02484

PLANNING AND PROVIDING AN ADEQUATE SUPPLY OF WATER FOR ORANGE COUNTY, CALIFORNIA,
Orange County Water District, Santa Ana, Calif.
For primary bibliographic entry see Field 02L.
W70-02487

THE CHALLENGE OF WATER MANAGEMENT: ORANGE COUNTY WATER DISTRICT, CALIFORNIA,
Orange County Water District, Santa Ana, Calif.
For primary bibliographic entry see Field 02L.
W70-02489

VALUE OF DESALTED WATER FOR IRRIGATION,
Bureau of Reclamation, Denver, Colo.; and Bureau of Reclamation, Boulder City, Nev.
E. S. Krous, J. P. Wagner, W. A. Fernelius, John T. Maletic, and Harold L. Parkinson.
Available from Superintendent of Documents, US Government Printing Office, Wash DC, 20402 - Price $2.00. Office Saline Water Research and Development Progress Report No 489, Oct 1969. 158 p, 10 fig, 5 dwg, 69 tab, 28 ref.

Descriptors: *Desalination processes, *Water costs, *Irrigation, *Water quality, Irrigated land, Land reclamation, Electrodialysis, Flash distillation, Desalination plants, Brine disposal, Boron, Cost analysis, Waste disposal.
Identifiers: Sodium adsorption ratio, Multistage flash distillation.

The water quality benefits associated with desalted irrigation water at concentrations of 400, 900, and 1,500 parts per million were determined for three irrigated areas in Arizona and California. Desalination for irrigation is most favorable in areas producing crops that yield high net farm incomes under yearlong growing seasons. Irrigation developments of about 10,000 acres require large-scale multistage flash distillation plants utilizing nuclear energy, but electrodialysis is more favorable for smaller irrigated areas. The sodium adsorption ratio and boron content of product water must be reduced to assure sustained productivity. Benefit-cost analysis indicates that 400 ppm (TDS) is the optimum product water quality. Unit water cost was least in larger plants. A serious problem associated with inland desalting is brine disposal. (Carstea-USGS)
W70-02632

OPTIMIZING SALVAGEABLE WATER RESOURCES IN A SEMI-ARID INLAND BASIN,
Arizona Univ., Tucson.
W. Clyma, W. G. Matlock, W. J. McConnell, H. K. Qashu, and S. D. Resnick.
Available from the Clearinghouse as PB-188 933, $3.00 in paper copy, $0.65 in microfiche. Project Completion Report, Arizona Water Resources Center, Aug 1969. 45 p, 5 tab, 9 fig, 10 ref. OWRR Project A-011-ARIZ.

Descriptors: *Water reuse, *Natural recharge, Treatment, Water management (Applied), Arid lands.

This investigation characterizes salvageable water resources in the semi-arid Tucson basin and evaluates appropriate treatment and control methods and management procedures for reuse of these salvageable waters. A preliminary inventory of salvageable water resources in the Tucson basin indicated a conservatively estimated annual total of 30,000 acre-feet available from municipal, industrial, and urban runoff sources. Little was known of the quality of urban runoff in this semi-arid environment, and efforts were directed toward exploratory sampling and analysis as indicators of potential problem areas in runoff quality. A groundwater recharge investigation at the Rillito Creek recharge site near Tucson produced a mathematical model which can be applied to alternative management schemes in the utilization or storage of salvage waters. Initial formulation of management alternatives appeared to require an improved system framework defining community objectives and criteria for salvaged water allocation. (DeCook-Arizona)
W70-02745

3D. Conservation in Domestic and Municipal Use

CONSERVATION OF NATURAL RESOURCES.
Wis Stat Ann secs 23.095, 23.11, 23.26 (1964), as amended, (Supp 1969), 23.093 (Supp 1969).

Descriptors: *Wisconsin, *Natural resources, *Administrative agencies, *Coordination, Piscicides, Fish control agents, Conservation, Parks, Forests, Forest management, Fish hatcheries, Access routes, Land use, Road construction, Soil management, Wildlife management, Administration, Water management (Applied), Legislation, Carp, Investigations.

The Conservation Commission is authorized to contract with public or private agencies for research and development of a toxic material for the control and eradication of carp in state waters. The Commission is further authorized to establish and maintain state fish hatcheries and care for and protect all state forests. The Commission may acquire needed access routes to lands under its control which are surrounded by privately owned lands. The Commission shall periodically report to the Governor on its activities and on the results of its investigations. Such reports shall be accompanied by appropriate recommendations for the conservation and preservation of the state's natural resources. A Natural Resources Committee of state agencies is created to coordinate conservation programs of the several participating agencies. The Committee shall investigate and make recommendations to the state agencies and to the legislature concerning soils, waters, fish, forests, wildlife, and other natural resources of the state. It is a misdemeanor to unreasonably waste or maliciously impair or destroy any natural resource of the state. (Dearing-Florida)
W70-02587

CONSERVATION ACT.
Wis Stat Ann sec 23.09 (1964), as amended, (Supp 1969)

Descriptors: *Wisconsin, *Water resources development, *Conservation, *Fish management, Recreation, Water conservation, Administrative agencies, Regulation, Local governments, Interagency cooperation, Project planning, Surveys, Publications, Fish conservation, Watershed management, Forest management, Fish hatcheries, Fish stocking, Drowning, Access routes, Condemnation, Navigable waters, Financing, Scenic easement, Leases, Beaches.
Identifiers: Water rescue.

The Conservation Commission may promulgate and publish rules and regulations, conduct studies, disseminate information, and provide services to residents for the furtherance of forest, fish, game, and water conservation. The Commission is further empowered to: (1) acquire easements and other property interests in lands and waters by purchase, gift, condemnation, lease, or agreement; (2) grant leases and easements to properties under its management in the interest of conservation; (3) establish and maintain fish refuges and hatcheries, and to propagate and sell fish for stocking waters of the state; (4) maintain state forests to protect watersheds; (5) develop a program for classifying lakes and streams by use; (6) assist the county boards in condemnation of rights-of-way to any navigable stream, lake, or other waters for public use; (7) provide public fishing grounds; (8) provide matching funds to local governments for the acquisition of public access routes to any navigable waters and for the development of county recreational facilities including beaches; and (9) assist local governments in programs for the rescue of persons lost or in danger in state forests or waters and in the recovery of victims of drownings. (Dearing-Florida)
W70-02816

3E. Conservation in Industry

WATER FOR INDUSTRIAL DEVELOPMENT IN COVINGTON, JEFFERSON DAVIS, LAMAR, LAWRENCE, MARION, AND WALTHALL COUNTIES, MISSISSIPPI,
Geological Survey, Jackson, Miss. Water Resources Div.
R. E. Taylor, C. P. Humphreys, Jr., and D. E. Shattles.
Geol Surv - Mississippi Research and Development Center Cooperative Rep, 1968. 114 p, 56 fig, 19 tab, 18 ref, 3 append.

Descriptors: *Water resources, *Mississippi, Groundwater, Surface waters, Streamflow, Water wells, Water quality, Hydrogeology, Hydrologic data, Data collections, Water resources development, Industrial water, Aquifers.
Identifiers: *Lamar County, Covington County, Jefferson Davis County, Marion County, Walthall County, Lawrence County.

Covington, Jefferson Davis, Lamar, Lawrence, Marion, and Walthall Counties in south-central Mississippi possess surface and groundwater in quantities capable of supporting large industrial and municipal developments. The area uses an aggregate of 9.7 mgd, and present industrial and municipal supplies are obtained predominantly from groundwater. However, more than 7 times this daily rate of withdrawal has been allocated from the Pearl River alone for a new industry. The largest single source of fresh water in the area is the Pearl River. Even during a 10-year drought, natural flow of the Pearl increases from 160 mgd at the northern Lawrence County line to 700 mgd at the southern Marion County line. This 540 mgd pickup in flow, as the river passes through the study area, is furnished mostly by tributary streams which are among the highest yielding streams in Mississippi. Water in the streams is of good quality, even though some wastes are discharged to the streams. Sedimentary aquifers of Eocene to Holocene age contain the fresh groundwater. Aquifers of Miocene age are available throughout the 6 counties. These aquifers not only supply present indus-

trial and municipal water demands but offer the greatest wateresupply potential in the area. Transmissibility values calculated for Miocene aquifers ranged from 2,400 to 400,000 gpd per foot, and for the Pearl River alluvium the value was 35,000 gpd per foot. Specific capacities of wells range from less than 1 to 70 gpm per foot of drawdown. The groundwater is of generally good quality and requires little or no treatment for most uses. (Knapp-USGS)
W70-02478

3F. Conservation in Agriculture

INFILTRATION OF WATER INTO NONUNIFORM SOIL,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
For primary bibliographic entry see Field 02G.
W70-02447

ALFALFA WATER TABLE INVESTIGATIONS,
Agricultural Research Service, Reno, Nev. Soil and Water Conservation Research Div.
For primary bibliographic entry see Field 02I.
W70-02450

THE ECONOMIC IMPACT OF IRRIGATED AGRICULTURE ON THE ECONOMY OF NEBRASKA,
Nebraska Univ., Lincoln. Dept. of Economics.
Theodore Roesler, F. Charles Lamphear, and M. David Beveridge.
Nebr Econ and Bus Rep No 4, Nebr Univ, Sept 1968. 59 p, 36 tab, 7 chart, 3 append.

Descriptors: *Irrigation, *Economics, *Kansas, *Input-output analysis, *Economic impact, Mathematical models, Simulation analysis, Operations research, Systems analysis, Cost analysis, Agriculture, Benefits.
Identifiers: *Irrigation economics.

The economic effects of irrigation on the economy of Nebraska were studied by input-output analysis. Nebraska is one of the West North Central states. With its 77,227 sq mi of area, it ranks fifteenth among the states in land area. It had a population of 1,411,000 in 1960, ranking 34th. Its per capita personal income in 1963 was $2,312, 25th among the states and 94% of the U.S. average of $2,449. The total induced by effect of irrigated agriculture in 1963 was $157.0 million. Households show the biggest impact, experiencing increased income of over $5,200. This includes not only the increased personal income of farmers but also increases in the personal incomes of all persons engaged in supplying needed inputs to the Irrigated Crops Sector. The Real Estate and Trade Sectors experienced the next largest increases in transactions. (Knapp-USGS)
W70-02479

STUDIES IN THE TECHNIQUES OF FIELD TRIALS IN RANGE LANDS: I. SIZE, SHAPE AND ARRANGEMENT OF PLOTS,
Central Arid Zone Research Inst., Jodhpur (India).
M. B. Jain.
Annals of Arid Zone, Vol 6, No 2, p 129-137, 1967. 4 tab, 14 ref.

Descriptors: *On-site investigations, *Arid lands, *Range management, *Range grasses, *Research and development, Statistics, Ranges, Natural resources, Vegetation, Plant populations, Desert plants, Statistical models, Costs, Economics, Economic efficiency.
Identifiers: *India, *Experimental designs, Research efficiency, Experimental error, Experimental efficiency, Plots.

In India enormous livestock population and resulting overgrazing are causing rapid deterioration of range lands. Thus the livestock economy is causing deterioration of natural resources and is becoming a drag on the whole economy. Improved range management is a must and necessarily depends on sound research. The author reports a study intended to improve research efficiency through better experimental plot design for Indian conditions. Trials were conducted on 'poor' condition range land in arid western Rajasthan, India. The author concludes that small plots require less experimental area (hence less natural variation) and are most economical from the standpoint of land. On the other hand, a large number of small plots with a large proportion of border area is expensive from the standpoint of fencing and labor. For Indian conditions the author concludes that long term grazing studies should be conducted on plots large enough to meet year round requirements without causing deterioration of the range. Plot size would vary according to carrying capacity of different range lands. Plot shape has to be nearly square to minimize fencing costs. To reduce error the experimental area should be stratified on the basis of vegetative composition. The problem of decreased efficiency with increased size suggests confounded designs for factorial treatments, and incomplete blocks for varietal trials. The arrangement of plots should always be as compact as possible. (Crouse-Arizona)
W70-02551

STUDY ON THE PASTURE ESTABLISHMENT TECHNIQUE: III. EFFECT OF INTERCROPPING WITH DIFFERENT LEGUMES ON THE GROWTH AND FORAGE PRODUCTION OF DHAMAN (CENCHRUS CILIARIS) AND SEWAN (LASIURUS SINDICUS) PASTURES IN THE ESTABLISHMENT YEAR,
Central Arid Zone Research Inst., Jodhpur (India).
H. S. Daulay, A. K. Chakravarty, and G. N. Bhati.
Annals of Arid Zone, Vol 7, No 2, p 265-269, 1968. 7 tab, 1 fig, 6 ref.

Descriptors: *Legumes, *Arid lands, *Range management, *Revegetation, *Soil mosture, *Productivity, Water conservation, Ranges, Range grasses, Forages, Pasture management, Root zone, Costs, Economics, Grazing, Sands, Crop production, Seeds, Fertility.
Identifiers: *India, *Rajasthan, Intercropping.

In arid western Rajasthan 80% of the range land is in poor condition from over grazing and produces less than 300 kg. per hectare. Reseeding has proven difficult although of vital importance to the livestock industry. The authors report a one year study of the effect of mixing important range grasses - dhaman (Cenchrus ciliaris) and sewan (Lasiurus sindicus) - with three common legumes, mung (Phaseolus radiatus), moth (Phaseolus aconitifolius) and guar (Cymopsis tetragonoloba). A split-plot design with 4 replications was run on sandy soil at Jodhpur. There were 7 treatment combinations at 3 fertility levels. Intercropping of dhaman and sewan with the legumes produced an increase in forage yield of 20 to 30% compared with grass alone. Under arid conditions best increases in yield were with moth and guar. Estimated increases in income during the first year were (Rs. 249.46) per hectare with moth and (Rs. 208.75) with mung. An additional benefit was soil moisture conservation when dhaman was mixed with legumes. At the end of the first season soil moisture under dhaman - legume mixtures was higher at the 25, 50, and 75 cm. depths. No such increase occurred with sewan mixtures. (Crouse-Arizona)
W70-02554

EXPRESSING IRRIGATION EFFICIENCY IN TERMS OF APPLICATION TIME, INTAKE AND WATER ADVANCE CONSTANTS,
Texas Water Rights Commission, Basin Hydrology Section; and Utah State Univ., Logan. Dept. of Agricultural and Irrigation Engineering.
Yu-Si Fok, and A. A. Bishop.
American Society of Agricultural Engineers, Transactions, Vol 12, No 4, p 438-442, 1969. 2 tab, 6 fig, 11 ref.

Descriptors: *Irrigation efficiency, *Irrigated land, *Consumptive use, *Arid lands, *Timing, Irrigation practices, Surface irrigation, Application methods, Water conservation, Agricultural engineering, Equations, Rates of application, Water reuse, Runoff.
Identifiers: *Water advance equation

In arid and semiarid lands surface irrigation constitutes more than 75% of consumptive use of water. Therefore, an increase in irrigation efficiency of only 10 percent will result in saving a large amount of water for use elsewhere. Drawing on available literature, the authors develop mathematical and graphical expressions of irrigation efficiency in terms of application time, intake and water advance constants. Application efficiency is shown to be a dependent variable of the exponent of the intake and the water advance equations, and the ratio of intake time to water advance time. Proper use of these three variables can result in higher application efficiency. In practice, however, only the time ratio is easily manageable. Therefore, for each farm the length of irrigation run should be designed to achieve a high time ratio. (Crouse-Arizona)
W70-02556

THE EFFECT OF GYPSUM ON THE WATER STORAGE IN A SANDY LOAM SOIL UNDER AN IRRIGATED PERENNIAL PASTURE,
Commonwealth Scientific and Industrial Research Organization, Riverina (Australia). Riverina Lab.
For primary bibliographic entry see Field 02G
W70-02557

IRRIGATION IN ARID LANDS,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Irrigation Research Lab.
E. R. Hoare.
Institution of Agricultural Engineers, Journal and Proceedings, Vol 23, No 1, p 29-33, 1967. 4 tab, 2 fig.

Descriptors: *Arid lands, *Irrigation, *Evaporation, *Environmental effects, *Productivity, Irrigation systems, Rainfall, Climatic zones, Crop production, Human populations, Semiarid climates, Irrigation practices, Effective precipitation, Topography, Salinity, Fertilizers, Technology, Solar radiation, Agriculture, Irrigation efficiency, History.
Identifiers: *Australia, *Western U.S., *Pakistan, *India, *China, England.

This paper is the published form of a lecture given by the author in memory of Mr. Jack Wright, an English irrigation authority who designed, manufactured, and installed irrigation systems in many arid lands of the world. There is a brief review of the 4,000-year history of irrigation in arid lands of the Ancient World and of meteorological and topographic causes of aridity. The author compares a moderate rainfall zone in England with a semiarid zone of Australia to illustrate that aridity is often the result of a combination of high evaporative potential and relatively low rainfall - not just sparse rainfall. Because arid lands usually occur in areas with high levels of sunshine, application of irrigation water on suitable soils can result in high crop yields or even several crops per year. The need for sufficient water and adequate drainage to prevent salinity is covered briefly. The author estimates some 400 million acres are irrigated around the world, supporting about 400 million people at present. With increased fertilizers and technology, this area might support between 800 and 1200 million people. Unfortunately, potential for increasing the actual area under irrigation is low in precisely those areas where excess population is most critical: Pakistan, India and China. (Crouse-Arizona)
W70-02559

THE MAJARDAH SCHEME,
Long Island Univ., Greenvale, N.Y. C. W. Post Coll.
Robert S. Harrison.

Focus, Vol 19, No 5, p 8-11, Jan 1969. map.

Descriptors: *Semiarid climates, *Soil conservation, *Irrigation, *Land tenure, *Agriculture, Terracing, Erosion control, Reforestation, Productivity, Economic impact, Income, Irrigated land, Irrigation programs, Multi-purpose projects, Land reclamation, Drainage, Drainage systems, Salinity, Flood control, Wheat, Vegetable crops, Fruit crops, Land use, Social impact.
Identifiers: *Tunisia, *Mediterranean climate, *Agricultural processing plants, *Majardah Basin, Resettlement.

In Tunisia the area with the best potential for large scale irrigation is the Majardah Basin. The scheme is based on a French plan based on Marshall Plan funds. After independence the plan, which originally emphasized irrigation, was revised to include conservation and changes in land use and tenure based on the agrarian reform law of 1958. The area extends over 741,000 acres of the valley north to the Mediterranean. The river is fed by winter rains typical of the semiarid Mediterranean climate. Storage reservoirs are necessary to conserve the irregular river flow. The soils are fertile alluvium which supported prosperous agriculture in Roman times. Lower valley soils are heavy and require drainage systems. The goal is to irrigate 176,000 acres by 1971. Three multipurpose dams store water, control flooding and dilute saline waters. The irrigation canal system and drainage systems are described briefly. Erosion problems in the drainage basin are being controlled by terracing and reforestation. Land use plans are converting cultivation from extensive grains to intensive high value crops for the Tunis and European markets. Land reform has limited holdings to 150 acres and vastly increased the number of land owners. Agricultural product processing plants are being established. Already there has been a large increase in productivity and per capita income. (Crouse-Arizona)
W70-02560

WATER REQUIREMENTS OF LAWNGRASS,
Nevada Agricultural Experiment Station, Reno; and Agricultural Research Service, Amex, Iowa. Soil and Water Conservation Research Div.
For primary bibliographic entry see Field 02D.
W70-02562

SPRINKLER IRRIGATION SPRAY TEMPERATURES,
Agricultural Research Service, Kimberly, Idaho. Soil and Water Conservation Research Div.; and Agricultural Research Service, Kimberly, Idaho. Snake River Research Center.
C. H. Pair, J. L. Wright, and M. E. Jensen.
American Society of Agricultural Engineers, Transactions, Vol 12, No 3, p 314-315, 1969. 1 tab, 3 fig, 7 ref.

Descriptors: *Irrigation water, *Sprinkler irrigation, *Water temperature, *Temperature control, *Micrometeorology, Irrigation, Temperature, Soil temperature, Cooling, Idaho, Soil-water-plant relationships, Heating, Crop response, Drops (Fluids).
Identifiers: *Wet-bulb temperature, Snake River Valley.

Temperatures of irrigation water may vary from near zero to 90 C where the source is a hot spring. As more nuclear power plants are installed, streams into which waste water is discharged may also become heated. It is important to know what the water temperature is when it comes in contact with the crop or soil. Temperature can affect seed germination, growth, fruit developments, response to frost and crop-cooling operations. In theory droplets from sprinkler irrigation should approach the wet-bulb temperature of the air. The authors describe an experiment conducted in southern Idaho to test this theory. They found that near zero temperature of irrigation water increased to within 1.8 C of wet-bulb temperature and decreased from near boiling to within 3.4 C of wet-bulb temperature when applied by sprinkler. Heating of as much as 8 C and cooling of approximately 75 C were recorded. There was little variation in temperature with distance from the sprinkler. (Crouse-Arizona)
W70-02563

MULTIPLE USE OF MEDITERRANEAN RANGE LANDS; NEW APPROACHES TO OLD PROBLEMS,
Technion - Israel Inst. of Tech., Haifa. Dept. of Agricultural Engineering.
Z. Naveh.
Annals of Arid Zone, Vol 7, No 2, p 163-177, 1968. 1 tab, 2 fig, 29 ref.

Descriptors: *Multiple purpose projects, *Semiarid climates, *Land use, *Range management, *Decision making, Recreation demand, Arid lands, Agriculture, Arable land, Natural resources, Vegetation, Reforestation, Brush control, Carrying capacity, Conservation, Grazing, Surveys, Ecology, Watershed management, Pine trees, Grasses, Shrubs, Goats, Forests, Optimum development plans, Pasture management.
Identifiers: *Israel, *Mediterranean climate.

In Israel and other arid and semiarid Mediterranean lands increasing populations have put great pressure on food supplies from arable lands. A new look at renewable natural resources of the much abused rangelands is in order. The author estimates that from 40 to 64% of the land area of these countries is in hilly wildlands unsuitable for tillage. The climate is typically mediterranean with long, hot and very dry summers. These lands are generally overgrazed and eroded and yield low productivity. In recent years the trend has been to convert these lands to forestry and close them to grazing. Other areas have been taken over by unproductive but tenacious woody shrub species which in effect closes them to grazing. The author proposes a more flexible policy toward these wild lands which would permit utilization such as forestry, grazing, recreation, watershed management or possibly a combination of some or all of these. The decisions should be based on careful surveys of the site potential and local needs. Research is needed to provide a sound basis for dynamic programming of optimum land use. (Crouse-Arizona)
W70-02567

DETERMINATIONS OF LEAF AND FRUIT WATER POTENTIAL WITH A PRESSURE CHAMBER,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Irrigation Research Lab.
For primary bibliographic entry see Field 02I.
W70-02568

SOME EXPERIENCE IN THE DEVELOPMENT OF LAND IN THE NEW IRRIGATION ZONE IN THE GOLODNAYA STEPPE (RUSSIAN),
A. Ramazanov, G. E. Baturin, and V. D. Lazaridis.
Gidrotekhnika i Melioratsiya, No 9, p 40-49, Sept 1969. 3 fig, 9 tab, 2 ref.

Descriptors: *Land development, *Land reclamation, *Irrigation, *Deserts, Cotton, Crops, Drainage systems, Geology, Hydrogeology, Topography, Soils, Irrigation canals, Corn (Field), Soil moisture, Salinity, Water level fluctuations.
Identifiers: *USSR, Soviet Central Asia.

To identify the irrigation drainage systems and crops best suitable for land development in the Golodnaya Steppe, Soviet Central Asia, experimental drainage systems for growing rice, cotton, and grass were investigated using some selected steppe plots. Intensive irrigation of lands located in the southeastern part of Golodnaya Steppe leads to basic changes in the water and salinity regimes of the soil. Moreover, the present methods of reclamation, as conducted in the steppe, do not guarantee satisfactory reclamation of irrigated lands. (Gabriel-USGS)
W70-02648

FREE WATER FLOW TO ROWS OF WELLS (RUSSIAN),
Cairo Univ. (Egypt).
For primary bibliographic entry see Field 02F.
W70-02657

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

ANALYSIS OF INFLITRATION INTO DRAINING POROUS MEDIA,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
For primary bibliographic entry see Field 02G.
W70-02448

A DECADE, RESEARCH IN LAND AND WATER MANAGEMENT, 1957-1967,
Institute for Land and Water Management Research, Wageningen (Netherlands).
For primary bibliographic entry see Field 06B.
W70-02495

DRAINAGE RIGHTS.

R I Gen Laws Ann secs 46-20-1, 46-20-3 (1956).

Descriptors: *Rhode Island, *Drainage, *Drains, *Ditches, Legislation, Legal aspects, Drainage practices, Damages, Cities, Construction, Relative rights, Local governments, Administration, Decision making, Adjudication procedure, Administrative decisions.
Identifiers: *Drainage rights, Hearings.

Landowners desiring to drain their land but who are unable to obtain the consent of owners of land to be affected may petition their town council for power to drain their lands. The petition will set forth the course of the proposed drain and the names of the proprietors whose lands are to be affected thereby. The town council will hear the parties in interest and may appoint three disinterested parties to recommend the best drainage method and a fair damage award for the adversely affected party. The town council will make such orders based on the report as it deems lawful and right. (Keith-Florida)
W70-02515

CLAIMS AGAINST AND CONTRACTS WITH OTHER DISTRICTS AND MUNICIPAL CORPORATIONS EXERCISING DRAINAGE POWERS.

111 Ann Stat ch 42, secs 11-1 thru 11-17 (Smith-Hurd 1956), as amended, (Supp 1969).

Descriptors: *Illinois, *Drainage systems, *Drainage districts, *Cost allocation, Legislation, Administration, Regulation, Drainage, Drainage programs, Drainage engineering, Drainage practices, Administrative agencies, Judicial decisions, Cost sharing, Operation and maintenance, Adjudication procedure, Cost-benefit analysis, Cost repayment.
Identifiers: Penalties.

Any drainage district may connect its drains or levees to the drains or levees of another district. When work done by one drainage district benefits another, the benefitted district is liable for the just proportion of the cost of the work. Claims between districts may be settled by written contract, but such contract must be approved by the court having jurisdiction over the districts. Procedures are provided for hearings to fix the proportionate share of costs when districts are unable to agree. Judgement may be for money damages relating directly

to the amount of annual benefits between the parties. The judgement also constitutes the measure of liability between the districts for repair, maintenance and operation of the work. Any two or more adjoining drainage districts may establish joint systems. (Moulder-Florida)
W70-02516

PETITION TO COURT FOR DRAINAGE AND APPOINTMENT OF COMMISSIONERS.

Pa Stat Ann tit 3, secs 721-736 (1963).

Descriptors: *Pennsylvania, *Drainage, *Surface drainage, *Land development, Agricultural engineering, Legislation, Legal aspects, Subsurface drainage, Surface waters, Drains, Damages, Regulation, Excavation, Maintenance, Overflow, Swamps, Marshes, Surveys, Costs, Estimated costs, Drainage effects, Controlled drainage, Groundwater, Relative rights.
Identifiers: *Drain construction, Public nuisance.

When landowners desire to improve their land for agricultural purposes by surface or subsurface drains and such drains must be extended over or under the land of others to be effectual, the land owners must present a petition to the court of quarter sessions of the county where the land is located. The court will appoint viewers to make a feasibility study of the proposed drains and to report to the court the estimated damages which will be caused by the construction of the drains. The report will be accompanied by a plot of the proposed drains. The court will not confirm the report until damages have been paid to the parties to be injured, and drain construction will not begin until confirmation of the report. The petitioner and his successors in interest must keep the drains in repair or have them closed. A similar procedure is provided to cover the situation where the joint and several owners of swamp land desire to have their land drained, but if such land is deemed a public nuisance by the examining commissioners, the townships in which it lies may be apportioned part of the drainage expense. (Keith-Florida)
W70-02520

CITIES' POWER OVER WATERCOURSES.

Pa Stat Ann tit 53, secs 38401-38409 (1957).

Descriptors: *Pennsylvania, *Cities, *Watercourses (Legal), Jurisdiction, Rivers, Streams, Dams, Dam construction, Federal Government, Water resources development, Sanitary engineering, Waste disposal, Local governments, Legislation, Banks, Bank protection, Channels, Channel improvement, Beds, Confined water, Damages, Eminent domain, Condemnation, Navigable waters, Water sources, Water supply.

Cities may by ordinance establish the lines of banks, change channels, beds, and mouths of watercourses through lands or waters in or adjacent to the city. Cities may also crib, wall, confine, pave, inclose, prevent and remove obstructions, or build dams. For such purposes the power of eminent domain may be exercised. Notice of any such action must be given, and viewers are appointed to assess damages. These provisions shall not apply to any watercourse used by any municipality or water company as a source of supply. Whenever the consent of the federal government has been granted to a city to construct a dam in a public navigable river or stream for improving sanitary conditions, such city may take private property for that purpose. (Smith-Florida)
W70-02524

CITIES OF THE SECOND CLASS: POWERS RELATING TO LEVEES, FERRIES, WHARVES, CHANNELS, PIERS, AND INFLUENT PIPES.
Pa Stat Ann tit 53, sec 23138, 23139, 23155 (1957)

Descriptors: *Pennsylvania, *Cities, *Water supply, *Piers, Pipelines, Pumped storage, Reservoir operation, Reservoir storage, Water storage, Water tanks, Water wells, Water works, Influent streams, Engineering structures, Structures, Aqueducts, Pipes, Transportation, Conveyance structures, Wells, Legislation, State governments, Levees, Navigable waters, Channel improvement, Docks.
Identifiers: *Ferries.

Cities of the second class in Pennsylvania shall have the general powers necessary to: (1) provide for the construction and maintenance of levees and ferries within the city limits; (2) erect and regulate wharves on navigable waters adjacent to the city; (3) establish wharf and dock lines; (4) establish and change the channels of watercourses, and to wall and cover them; (5) establish and regulate public wells, cisterns, aqueducts, and reservoirs of water, and to fill the same; and (6) lay influent pipes of water works out into the bed of adjacent rivers, and to build a pier, for the purpose of procuring a pure water supply. Piers and influent pipes when laid must not obstruct navigation. (Marsee-Florida)
W70-02525

INTERFERENCE WITH DRAINAGE FACILITIES.

Pa Stat Ann tit 53, sec 57067 (1957).

Descriptors: *Pennsylvania, *Drainage systems, *Obstruction to flow, *Permits, Drainage, Drainage practices, Local governments, Drainage programs, Outlets, Pipes, Sewers, Storm drains, Water control, Water sources, Drains, Ditches, Culverts, Legislation, Legal aspects.

No person shall interfere with any drainage facility in a township without first submitting plans to the town commissioners for their approval. The commissioners may hold public hearings, alter the plans, and may grant complete or conditional approval. No drainage facility shall be interfered with except in strict accordance with plans so approved. Said commissioners may enter upon any lands or enclosures and maintain and repair drains or ditches as necessary to carry water from streets or highways. Nothing contained herein shall restrict the normal duties and powers of the State Department of Highways, any county, or the Water and Power Resources Board. (Smith-Florida)
W70-02526

FLOOD CONTROL.
Pa Stat Ann tit 32, secs 651, 654, 658-665 (1967), as amended, (Supp 1969).

Descriptors: *Pennsylvania, *Flood control, *Floodproofing, *Flood protection, Flood routing, Channel improvement, Check structures, Dams, Dikes, Diversion, Drainage systems, Flood forecasting, Flow control, Levees, Bridges, Highways, Reservoirs, Recreation facilities, Warning systems, Eminent domain, State governments, Federal government, Administrative agencies, Water resources development, Legislation.

The Department of Forests and Waters is authorized to survey sections of the Susquehanna River and prepare plans for the widening, deepening, removal of obstructions, repair of walls or changing the channel in order to obviate flood dangers. The Water and Power Resources Board is empowered to make surveys and plans for a proposed flood control district to control, store, preserve, and regulate the flow of rivers and streams to diminish or eliminate floods. Official plans are effective and the flood control district is established when the Board completes suitable plans. In carrying out official plans the Board may improve or alter the channel of any river, install flood warning systems, fill up any abandoned water course, construct dams, levees, and other flood control works which regulate rivers' flow, construct bridges, construct any other works needed for flood control. Lakes and reservoirs so constructed may be used for recreation. The Board may receive federal flood control aid. The Board shall have the power of eminent domain, and the power to authorize the federal government to acquire property or rights outside the Commonwealth at the Board's expense. (Smith-Florida)
W70-02531

UNITED STATES PROJECTS.
For primary bibliographic entry see Field 06E.
W70-02533

OBSTRUCTIONS NOT TO BE MADE OR ALTERED WITHOUT CONSENT.
Pa Stat Ann tit 32, secs 682-691 (1967)

Descriptors: *Pennsylvania, *Supervisory control (Power), *Dams, *Flood protection, Administrative agencies, Permits, Construction, Obstruction to flow, Highways, Bridges, Local governments, State governments, Flood control, Repairing, Legislation, Legal aspects, Regulation, Investigations.
Identifiers: Obstructions.

No person, corporation, municipality or county may construct any dam or other water obstruction or any addition thereto, or change and diminish the course or current of any body of water within the state unless authorized by the Water and Power Resources Board. Each application to the Board for such authorization shall be accompanied by complete maps and specifications of such water obstruction. The Board may impose restrictions upon a permit to construct or alter a water obstruction. The Board may investigate any dam or water obstruction now in existence, and may determine whether such structure is unsafe or in need of repair. The Board shall notify the owners of needed repairs or of the necessity of removal of any structure. This act extends to all types of water obstructions regardless of the date of construction. If the condition of the obstruction is so dangerous to public safety as to create an emergency, the obstruction may be removed or repaired without notice to the owner. The act shall not apply to private streams of a limited size. The act vests neither powers of eminent domain nor authority of other commissions in the Board. (Kelly-Florida)
W70-02534

PYMATUNING SWAMP DAM.

Pa Stat Ann tit 32, secs 762-773 (1967).

Descriptors: *Pennsylvania, *Dam, *Regulated flow, *Reservoirs, Construction, Alteration of flow, Condemnation, Area redevelopment, Recreation, Hunting, Fishing, Land use, Costs, Operation and maintenance, Management, Operations, Swamps, Drainage systems, Water supply, Water conservation, Legislation, Legal aspects, Regulation, Land development, Administrative agencies, Supervisory control (Powers).

The Department of Forests and Waters is hereby authorized to have a dam constructed and/or completed across the outlet of Pymatuning Swamp for the purpose of regulating water flow. The Department shall have plans and specifications prepared to construct the dam so as to conserve water, regulate the flow, and maintain as regular a flow as possible throughout the year. The reservoir and adjacent land acquired in connection with the project may be developed and used for recreation, hunting, fishing or game refuges. The Water and Power Resources Board is vested with complete authority concerning the use and development of the land and water within the project. The Department may use condemnation proceedings to acquire needed lands. The Department is authorized to obtain releases from landowners in Ohio whose property may be injured as a result of project construction. The Department may enter

agreements with persons or agencies in Ohio for removal or relocation of utility lines or roads. The Department may sell or lease lands, and sell timber or improvements on state lands where such transaction will be beneficial to the state. When the dam and reservoir are completed, the Department will be responsible for the maintenance and operation. (Kelly-Florida)
W70-02536

LOCATION AND IMPROVEMENT OF RIVERS AND STREAMS.
Pa Stat Ann tit 32, secs 807-811 (1967).

Descriptors: *Bank stabilization, *River training, *Pennsylvania, *River regulation, River beds, Streams, Dams, Impoundments, Boundaries (Property), River flow, Wildlife conservation, Water resources development, Bank erosion, Channel improvement, Stream stabilization, Legal aspects, Legislation, Administrative agencies, Regulated flow, Water policy, Stream improvement.

The Water and Power Resources Board of the Department of Forests and Waters is authorized to determine the course and define the location, width, and depth of any river or stream within the state, except the tidal waters of the Delaware River. The Board is hereby empowered to protect the bed and banks of any streams, build dams, retaining walls, and other structures for the purpose of regulating the flow of such streams or rivers, for the prevention of percolations from streams through holes in the beds or banks thereof, and for protection of wildlife and reparian owners. The Board shall record the location of a river or stream so fixed in the county deed records. The Board shall have the power to enter private lands for purposes of this act. Any damages sustained by any property owner, as a result of actions by the Board in fulfilling its statutory duties, shall be paid by the Department of Forests and Waters. (Kelly-Florida)
W70-02537

DELAWARE RIVER BRIDGES.
Pa Stat Ann tit 36, secs 3191, 3201, 3211, 3251, 3271, 3321, 3341, 3371 (1961).

Descriptors: *Pennsylvania, *Bridges, *Interstate rivers, *Interstate commissions, State governments, Governments, Interstate compacts, River basin commissions, Rivers, Streams, Delaware River, Delaware River Basin Commission, Eminent domain, Condemnation, Bridge construction, Parks, Public lands, Highway relocation, Road construction, Highways, New Jersey, New York, Legislation.

Whenever the Commonwealth shall acquire and maintain any toll bridge, the Board of Commissioners of Public Grounds and Buildings may lease to any adjacent borough or township, for public park purposes only, any lands acquired in connection with such bridge which are not required for highway purposes. The Department of Highways is authorized and directed to erect a toll bridge over the Allegheny River. In the construction of said bridge, the Department shall have all powers conferred with respect to relocation, widening or construction of highways, including eminent domain. 'Bridges' between Pennsylvania and New York are defined. The New Jersey Act for the protection of bridges over the Delaware River is hereby declared to be of force in this state. 'Bridges' between Pennsylvania and New Jersey are defined. Certain sums of money are appropriated for a commission to build and acquire toll bridges over the Delaware River in conjunction with a similar commission of New Jersey. Such commission is created to act as a joint commission with New Jersey commission and is authorized to determine the proper location of certain additional bridges. (Smith-Florida)
W70-02546

DELAWARE RIVER JOINT TOLL BRIDGE COMMISSION.
Pa Stat Ann tit 36, sec 3401 (1961), as amended, (Supp 1969).

Descriptors: *Pennsylvania, *New Jersey, *Interstate commissions, *Bridges, Interstate compacts, Bridge construction, Eminent domain, Condemnation, Delaware River Basin Commission, Delaware River, Rivers, Road construction, Highways, State governments, Port authorities, Legislation, Interstate rivers, Operation and maintenance, Administrative agencies, Harbors.

The Governor is authorized to enter into a compact with the State of New Jersey to create the Delaware Joint Toll Bridge Commission. Said Commission shall administer, operate, and maintain all joint state-owned bridges across the Delaware River and shall investigate and prepare plans for new bridges over said river. Said Commission is empowered to conduct all its affairs according to law, acquire and dispose of property, exercise the power of eminent domain, erect certain new bridges, charge and collect fees and tolls, acquire and operate port and terminal facilities, including the dredging of ship channels and turning basins, and exercise all other powers reasonably necessary to effectuate its authorized purposes. 'Port and terminal facilities' are defined. The Commission is empowered to acquire, construct and operate bridges at specified locations, to replace existing bridges, to acquire by purchase or condemnation any existing ferry or bridge in connection with the construction of a new bridge, to build or improve any road or highway in connection with a bridge project, and to demolish or remove any bridge which is to be replaced. (Smith-Florida)
W70-02547

REGULATION OF DAM AND MILLWAY CONSTRUCTION AND OPERATION.
Iowa Code Ann secs 469.1 to 469.31 (1949), as amended, (Supp 1969).

Descriptors: *Iowa, *Permits, *Dam construction, *Dams, Administrative agencies, Legislation, State governments, Cities, Legal aspects, Electric power, Hydroelectric plants, River regulation, Regulation, Washouts, Navigable rivers, Streams, Navigation, Riparian rights, Eminent domain, Embankments, Water utilization, Industrial water, Water pollution control, Highways, Waterfalls.

No dam may be constructed, maintained, or operated in any navigable or meandered stream for any purpose, or in other streams for manufacturing or power purposes, nor may any water be taken from such streams for industrial purposes, unless the Iowa Natural Resources Council has granted a permit therefor under the procedures established herein. Where the water is to be used for manufacturing purposes other than power development, no permit may be issued until the Iowa Water Pollution Control Commission has certified its approval of the water's use. Permits must also be obtained where dams affect highways or state-owned lands. This act also provides for: (1) permit allowance criteria; (2) dam construction and operation regulation; (3) nuisance proceedings to abate dams violating the act; (4) condemnation of lands for dams; (5) the construction of embankments on the land of others for bank protection; (6) the right to utilize falls below dams; (7) revocation of permits; (8) permits for existing dams; and (9) the assessment of damages arising from embankment construction and condemnation. Cities and towns may by complying with this act construct dams. (Marsee-Florida)
W70-02570

POWERS, RIGHTS, AND PRIVILEGES OF RAILROAD CORPORATIONS TO CROSS WATERCOURSES.
Miss Code Ann secs 7723, 7742 (1956).

Descriptors: *Mississippi, *Railroads, *Bridges, *Bodies of water, Legislation, Navigable waters, Non-navigable waters, Bridge construction, Boats, Docks, Streams, Rivers, Operation and maintenance, Construction, Transportation, Navigation, Mechanical equipment, Legal aspects.

Except as limited, or otherwise prescribed by federal statute or regulations, railroad corporations have the authority to contruct, maintain, or operate railroads under, over, or across any body of water which lies along its route; build and maintain bridges, landings and wharves; and operate any type of watercraft necessary in the conduct of its business. Whenever a navigable body of water is crossed by a bridge, a draw or swing sufficient to allow the passage of boats must be maintained. (Casey-Florida)
W70-02572

FLOOD CONTROL.
Miss Code Ann secs 4769-4771, 4773, 4774, 4776, 4782, 4789, 4790, 4792-4795, 4800, 4802, 4803, 4803-01, 4805-4808, 4810, 4815-4817, 4819, 4826-01 (1956).

Descriptors: *Mississippi, *Administrative agencies, *Flood control, *Project planning, Legislation, Administration, Federal government, State governments, Flood protection, Water management (Applied), Floodways, Conveyance structures, Projects, Federal project policy, Watershed management, Flood routing, Levees, Right-of-way, Engineering structures, Bypasses, Operation and maintenance, Maintenance costs, Operation costs, Highway relocation, Eminent domain.
Identifiers: *Flood control districts.

Flood control districts are established to participate in federal flood control projects at the local level. Petition requirements for establishing such districts are provided, as are the duties of the court-appointed examining engineer. The federal project plan is filed as the official plan of the district. The District Commissioners are given corporate powers. Commissioners are authorized to cooperate in the construction and maintenance of project works, to acquire necessary land, to relocate highways, and to exercise powers of eminent domain. Provisions are made for the enlargement and combination of districts and for cooperation between districts. Commissioners are empowered to obstruct watercourses and to provide for artificial bypasses for floodwaters. Preliminary and maintenance expenses may be financed by loans and ad valorem taxation of property within the districts. Districts continue after the completion of the official plan for the maintenance and protection of works constructed under the plan. (Douberley-Florida)
W70-02573

FLOOD CONTROL.

Miss Code Ann secs 4769-4771, 4773, 4774, 4776, 4782, 4789, 4790 (1956).

Descriptors: *Flood control, *Administrative agencies, *Project planning, *Project purposes, Flood protection, Rivers and Harbors Act, Water management (Applied), Overflow, Floodways, Conveyance structures, Engineering structures, Federal government, State governments, Administration, Projects, Administrative costs, Engineers estimates, Estimated costs, Watershed management, Federal project policy, Programs, Tax, Costs, Tax rate, Highway relocation.
Identifiers: *Flood control districts.

The court of chancery has jurisdiction to establish flood control districts to cooperate with the federal government in the implementation of federal flood control projects. A majority of the county supervisors may petition the chancellor to establish a district. The federal flood control proposal, the necessity for improvements, their purpose, the area to be protected, and a proposed name must be included

in the petition. A court-appointed engineer makes a feasibility study, accurately describes the lands involved, reports on the extent of all required improvements and their cost, and files the plan of the chief of engineers of the War Department with the chancellor. After proper notice, a hearing is held on the petition. The chancellor's order may be appealed by an elector, property owner, or any other person affected. The district commissioners have corporate powers, and are to adopt an official plan for the district with approval of the chancellor. Preliminary expenses are paid by an ad valorem tax upon property within the district. The commissioners may assure the federal government that the county will bear the expense for necessary highway alterations. (Douberley-Florida)
W70-02574

FLOOD CONTROL.

Miss Code Ann secs 4792-4795, 4800, 4802, 4803, 4803-01 (1956).

Descriptors: *Flood routing, *Floodways, *Highway relocation, *Projects, Flood control, Diversion structures, Drainage systems, Flood protection, Levees, Reservoirs, Reservoir operation, Watershed management, Floodproofing, Design flow, Right-of-way, Embankments, Sluice gates, Spillways, Pumping plants, Ditches, Channels, Conduits, Conveyance structures, Engineering structures.

Flood control districts are empowered to acquire property rights within or without the district to accomplish their purposes, and may bargain with land owners or settle claims for damages. They are empowered to cooperate with federal agencies in the construction and maintenance of necessary works and are to assure the federal government that works will be maintained, that highway relocations and damages will be supplied by the state, and that lands and easements will be provided. Commissioners have the power of eminent domain, using the same procedures as public utility condemnation procedures. The districts may cooperate with other districts within limits, and they may enlarge or combine with other districts upon petition to the chancellor. Commissioners may alter the official plan for works and improvements in accordance with changes in the original federal plan. Districts have the right to obstruct or dam any natural watercourse and to provide for artificial bypasses for flood waters so long as the water is returned to its natural watercourse. The power to construct bypasses is also granted to existing districts in protected levee areas. (Douberley-Florida)
W70-02575

FLOOD CONTROL.
Miss Code Ann secs 4805-4808, 4810, 4815, 4816, 4817, 4819, 4826-01 (1956).

Descriptors: *Financing, *Government finance, *Loans, *Taxes, Costs, Interest, Interest rate, Administrative costs, Initial costs, Maintenance costs, Operating costs, Reimbursable costs, Cost repayment, Tax rate, Cost sharing, Maintenance, Repairing, Operation and maintenance, Operations, Legislation, Bench marks.

Flood control district commissioners may, with approval of the chancellor, borrow funds to cover preliminary expenses to be paid from district funds, or if no works are constructed, an ad valorem tax may be levied. The tax is assessed annually until preliminary expenses, including expenses for highways and acquisition of property rights, are paid. An annual ad valorem tax may also be levied for maintenance and repair of flood control works and improvements. Emergency loans may be made, to be repaid from the first maintenance taxes thereafter collected. Commissioners may borrow money to make necessary highway improvements and to purchase property rights and interests. Reimbursements made by the federal government may be used by the commissioners. Upon completion of the official plan, districts will continue to maintain the works constructed under the plan. Commissioners have the right to police the works, compel citizens to help protect the works in great emergencies, and to prevent damage by prohibiting persons, vehicles or livestock from passing over works. Removal of bench marks or other reference marks is a misdemeanor. (Douberley-Florida)
W70-02576

THE LAW OF SURFACE WATER IN MISSOURI,
Lawrence O. Davis.
Mo L Rev, Vol 24, Nos 2, 3, p 137-165; 281-317, Apr, June 1959. 66 p.

Descriptors: *Missouri, *Surface waters, *Water law, *Legal aspects, Watercourses (Legal), Floodwater, Natural flow doctrine, Appropriation, Civil law, Reasonable use, Drainage districts, Levees, Legislation, Drainage, Surface drainage, Obstruction to flow, Alteration of flow, Terracing, Impoundments, Impounded waters, Judicial decisions, Railroads, Cities, Riddance (Legal aspects), Repulsion (Legal aspects).

Written in two installments, this article is broken into four major divisions. The first division discusses the distinguishing characteristics of surface water and watercourses, and devotes special attention to the status of floodwater as surface water. The second division deals with the law of surface water in general, with subdivisions including: (1) the civil law rule or natural flow theory; (2) the common law or common enemy rule; (3) the reasonable use rule; and (4) the civil law and common enemy rules in practice. The third major division covers the history of Missouri surface-water law. Lastly, the fourth division sets forth present Missouri surface-water law and discusses in subdivisions: (1) appropriation; (2) municipal corporations; (3) railroads; (4) drainage and levee districts; (5) statutory private drainage rights; (6) liability for the escape of water incidental to impounding; (7) blocking of water by a proprietor at his upper property line; (8) the privilege of the upper owner to alter flow; and (9) terracing for water management. (See also W70-02578 thru W70-02583). (Marsee-Florida)
W70-02577

THE LAW OF SURFACE WATER IN MISSOURI,
Lawrence O. Davis.
Mo L Rev, Vol 24, No 2, p 137-145, Apr 1959. 9 p.

Descriptors: *Missouri, *Watercourses (Legal), *Surface waters, *Surface runoff, Legal aspects, Judicial decisions, State governments, Artificial watercourses, Intermittent streams, Natural streams, Ephemeral streams, Streams, Running waters, Bogs, Fen, Marshes, Swamps, Surface drainage, Ditches, Drainage water, Floodwater, Water types, Flooding, Water law.

While it is obvious that the term surface water does not include percolating groundwater, surface water must also be distinguished from water in a natural watercourse. This is necessary because of the different treatment afforded each by Missouri courts. The usual approach to distinguishing between surface water and watercourses is a negative approach in that all waters not meeting the requirements of a natural watercourse are labeled as surface waters. The question is one of fact depending upon the physical situation. As typified by the Missouri cases discussed, the question is often close, especially as relates to drainways and sloughs. Paramount considerations in classifying a particular body of water are the source of the water, continuity of flow, the physical characteristics of the drainway, and the general lay of the land. As regards floodwater, Missouri treats all overflow as surface water whether or not such overflow remains contiguous with the main channel. There is one exception: where the overflow temporarily escapes from the stream and runs through a defined channel back into the main body of water, it is still regarded as part of the watercourse. (See also W70-02577) (Marsee-Florida)
W70-02578

THE LAW OF SURFACE WATER IN MISSOURI,
Lawrence O. Davis
Mo L Rev, Vol 24, No 2, p 145-154, Apr 1959. 10 p.

Descriptors: *Missouri, *Appropriation, *Riddance (Legal aspects), *Repulsion (Legal aspects), Surface waters, Legal aspects, Water law, Drainage, Drainage water, Surface drainage, Surface runoff, Reasonable use, Alteration to flow, Obstruction to flow, Relative rights, State governments, Judicial decisions, Prior appropriation, Artificial watercourses, Cities, Natural flow, Natural flow doctrine.

Relatively few cases deal with the appropriation of surface water; however, as a general rule a landowner has the absolute right to use the surface water on his land. Some jurisdictions qualify the rule by allowing appropriation only insofar as necessary to a reasonable use of the land. Determining liability to adjoining owners for the obstruction or repulsion of surface water is a more difficult matter. Three separate rules have developed to make such a determination: (1) the civil law rule makes liable a person who interferes with the natural flow of surface waters to another's detriment; (2) the common enemy rule gives each landowner unlimited privilege to drain or obstruct the surface water on his land; and (3) the reasonable use rule makes an owner liable only for unreasonable modifications to the natural flow. The civil law and common enemy rules have been criticized and have been modified in practice. The civil law rule has been held inapplicable to urban property, while the common enemy rule has been modified to prohibit the artificial discharge of water in a concentrated body upon lower land. Other minor exceptions are mentioned. (See also W70-02577). (Marsee-Florida)
W70-02579

THE LAW OF SURFACE WATER IN MISSOURI,
Lawrence O. Davis.
Mo L Rev, Vol 24, No 2, p 154-165, Apr 1959. 11 p.

Descriptors: *Missouri, *Judicial decisions, *Riddance (Legal aspects), *Repulsion (Legal aspects), Surface waters, Water law, Legal aspects, Drainage, Drainage water, Surface drainage, Surface runoff, Natural flow, Alteration of flow, Obstruction to flow, Railroads, Relative rights, State governments, Watercourses (Legal), Impoundments, Impounded waters, Reasonable use.

Since the case of Abbott v Kansas City, St. J and C.B.R.R., 83 Mo 271 (1884), which adopted the common enemy rule, the theory of surface water law in Missouri has never been seriously questioned. Prior to that, however, there was confusion as to what rule Missouri would follow. Some cases indicated that the civil law rule was followed; others indicated that the common enemy rule was favored. This historical discussion places these older cases in proper perspective to avoid misunderstanding of their significance today. (See also W70-02577). (Marsee-Florida)
W70-02580

THE LAW OF SURFACE WATER IN MISSOURI,
Lawrence O. Davis.
Mo L Rev, Vol 24, No 3, p 281-283, June 1959. 3 p.

Descriptors: *Missouri, *Appropriation, *Repulsion (Legal aspects), *Surface waters, Legal aspects, Riddance (Legal aspects), Water rights,

Priorities, Beneficial use, Percolating water, Groundwater, Judicial decisions, State governments, Overflow, Flooding, Water law.

This second installment of a two-part article on the surface water law of Missouri deals with the application of the common enemy rule in Missouri. While not directly governed by the common enemy doctrine, the landowner's right to appropriate the surface water on his land is also discussed. The extent of such appropriation has never been directly decided in Missouri; however, inasmuch as the common enemy doctrine is presumable based on the theory that every proprietor has complete dominion over the soil, it would seem logical that the right to appropriate would be practically unlimited. Some jurisdictions have applied the same rules of appropriation to both surface water and water percolating through the ground in no definite channel. A Missouri case has regarded such percolating water as a part of the soil but nevertheless prohibited malicious interference by the proprietor with its flow. This case could be extended to prevent malicious appropriation of surface water if surface water and percolating water are to be treated alike. Overflow water of a stream is generally treated as surface water in Missouri for appropriation purposes. (See also W70-02577). (Marsee-Florida)
W70-02581

THE LAW OF SURFACE WATER IN MISSOURI,
Lawrence O. Davis.
Mo L Rev, Vol 24, No 3, p 283-289, June 1959. 6 p.

Descriptors: *Missouri, *Cities, *Drainage districts, *Railroads, Surface waters, Legal aspects, Water law, Judicial decisions, Legislation, Municipal water, State governments, Levees, Repulsion (Legal aspects), Riddance (Legal aspects), Obstruction to flow, Alteration of flow, Drainage, Drainage water, Impoundments, Relative rights, Embankments, Roadbanks.
Identifiers: *Municipal corporations.

Because of its activity in street improvement and sewer construction, the municipal corporation is often involved in surface water litigation. Several cases are discussed as examples. Although it would appear that municipal corporations are favored due to their public nature, it may be that the liability of such corporation for the interference with the surface drainage is the same as that of a private individual. Much Missouri surface water litigation has resulted from railroad construction. An early case adopted the rule that a railroad must, if there is a watercourse nearby, provide openings through their roadbeds, and suitable ditches, so as to afford sufficient drainage. This idea has today been embodied in a Missouri statute. Considerable litigation has centered around the activities of statutorily created drainage and levee districts. The rights of landowners within such districts are governed by statute and contract. As to landowners outside the district, however, the district is a legal entity and treated much as an individual or political subdivision of the state. No special rules exist governing the common law rights of these districts. (See also W70-02577). (Marsee-Florida)
W70-02582

THE LAW OF SURFACE WATER IN MISSOURI,
Lawrence O. Davis.
Mo L Rev, Vol 24, No 3, p 289-298, June 1959. 9 p.

Descriptors: *Missouri, *Repulsion (Legal aspects), *Riddance (Legal aspects), *Impounded waters, Surface waters, Drainage, Surface runoff, Obstruction to flow, Alteration of flow, Barriers, Diversion, Relative rights, Judicial decisions, Legal aspects, Legislation, Impoundments, Drainage districts, Levees, Embankments, Drainage water, Earth dams, Railroads, Cities, Farms, Water law.

After discussing some statutes relating to private drainage rights, this article deals with a landowner's liability in Missouri for impounded surface water which either escapes or backs up onto another's land. From three Missouri cases considered, it is concluded that there is no liability for the escape of impounded surface water unless the escape is in a concentrated volume, or is the natural result of the impoundment or unless negligence is involved. Where the lower owner causes water to back up onto an upper owner's land, Missouri cases indicate that the lower owner is not liable if he blocks the water on the property line, but is liable if he does so elsewhere. This result is criticized. Blocking water at the property line may have two effects: the water may form a pond behind the embankment on the higher land, or it may be diverted across the lands of a third party. Missouri courts have made no distinction between these situations as relates to the liability of the impounder. Blockage as relating to urban areas, farming areas, and drainage and levee districts is discussed. (See also W70-02577). (Marsee-Florida)
W70-02583

PUBLIC LANDS AND SWAMPS - SALES - PUBLIC USE.
Wis Stat Ann secs 24.11 (3), 24.14, 24.145 (1964).

Descriptors: *Wisconsin, *Public rights, *Federal reclamation law, *Swamps, Public lands, Access routes, Contracts, Grants, Easements, Water rights, Mining, Mineralogy, Land reclamation, Patents, Federal-state water rights conflicts, State jurisdiction, Levees, Drains, Streams, Rivers, Ponds, Lakes.
Identifiers: *Public access, *Water-power rights.

Every contract, sale, or grant of public lands and waters shall reserve to the people the right of access for any purpose to such lands or streams, rivers, ponds, or navigable lakes bordered by such lands. There is further reserved all rights necessary to the full enjoyment by the people of such public lands and waters and all minerals therein. Such contract or conveyance is also subject to continued ownership by the state of all water-power rights and mineral removal rights on such lands. Any person who has purchased from the United States or entered any lands patented to this state as swamp and overflowed lands prior to the execution of such patents to the state, whose entry has been cancelled by the United States due to the subsequent patent to the state may purchase from the state such lands as were in the original patent from the United States at that original price. None of the swamp and overflow lands nor any proceeds from the sale of such lands are needed for the purpose of reclaiming such lands. These lands and the proceeds of their sale shall be made a part of the normal school fund. (Dearing-Florida)
W70-02588

FLOOD PLAIN INFORMATION OF SCAUAQUADA CREEK, IN THE TOWNS OF CHEEKTOWAGA AND LANCASTER, ERIE COUNTY, NEW YORK.
Corps of Engineers, Buffalo, N.Y.

Prepared for Erie-Niagara Basin Regional Water Resources Planning and Development Board. Corps Engineers Flood Plain Report, May 1969. 67 p, 42 fig, 8 plate, 11 tab.

Descriptors: *Floods, *Flood damage, *New York, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Cheektowaga (NY), Lancaster (NY), Erie County (NY), Standard project flood, Intermediate regional flood.

Flooding of Cheektowaga and Lancaster, Erie County, New York is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-02629

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN PENNSYLVANIA.
Corps of Engineers, Philadelphia, Pa. North Atlantic Div.

Corps Engineers Water Resources Development Report, Jan 1, 1969. 110 p, 2 fig, 63 photo, 1 plate, index.

Descriptors: *Water management (Applied), *Pennsylvania, *Water resources development, Navigation, River basin development, Flood control, Multiple-purpose projects, Hydroelectric power, Dams, River training.
Identifiers: U.S. Army Corps of Engineers projects (Penn).

U.S. Army Corps of Engineers water resources development projects in Pennsylvania are listed. The role of the Corps of Engineers in planning and building water resources improvements is described briefly, and the procedure for initiating such studies, authorization procedures, and status of projects are outlined. Projects described include navigation, flood control, multiple-purpose projects, river surveys, erosion control, water supply, water pollution, power, recreation, and flood plain studies. (Knapp-USGS)
W70-02644

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN NEW YORK.
Corps of Engineers, New York. North Atlantic Div.

Corps of Engineers Water Resources Development Report, Jan 1, 1969. 151 p, 7 fig, 2 plate, 77 photo, index.

Descriptors: *Water management (Applied), *New York, *Water resources development, Navigation, River basin development, Flood control, Multiple-purpose projects, Hydroelectric power, Dams, River training.
Identifiers: U.S. Army Corps of Engineers projects (NY).

U.S. Army Corps of Engineers water resources development projects in New York are listed. The role of the Corps of Engineers in planning and building water resources improvements is described briefly, and the procedure for initiating such studies, authorization procedures, and status of projects are outlined. Projects described include navigation, flood control, multiple-purpose projects, river surveys, erosion control, water supply, water pollution, power, recreation, and flood plain studies. (Knapp-USGS)
W70-02645

SOME EXPERIENCE IN THE DEVELOPMENT OF LAND IN THE NEW IRRIGATION ZONE IN THE GOLODNAYA STEPPE (RUSSIAN),
For primary bibliographic entry see Field 03F.
W70-02648

CALCULATION OF SLOPE STABILITY OF RIVERS AND DRAINAGE CANALS (RUSSIAN),
For primary bibliographic entry see Field 02E.
W70-02658

FLOOD PLAIN INFORMATION OF CANANDAIGUA OUTLET IN THE COUNTIES OF ONTARIO AND WAYNE, NEW YORK.
Corps of Engineers, Buffalo, N.Y.

Prepared for WA-ONT-YA Reg Water Resources Planning and Development Board. Corps Engineers Flood Plain Report, Dec 1968. 54 p, 18 fig, 11 plate, 13 tab.

Descriptors: *Floods, *Flood damage, *New York, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: Canandaiqua Lake (NY), Ontario (NY), Wayne (NY), Standard project flood, Intermediate regional flood.

Flooding of the Canandaiqua Lake Outlet, Ontario and Wayne Counties, New York is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-02667

DEVELOPMENT OF A MATHEMATICAL MODEL FOR THE SIMULATION OF FLAT-LAND WATERSHED HYDRAULICS,
Iowa State Water Resources Research Inst., Ames.
For primary bibliographic entry see Field 02G.
W70-02676

ALKALI SACATON SEEDLINGS: GERMINATION AND SURVIVAL IN AN AGAR AND SOIL MEDIUM,
Forest Service (USDA), Albuquerque, N. Mex. Rocky Mountain Forest and Range Experiment Station.
Earl F. Aldon.
USDA Forest Serv Res Note RM-156, 1969. 3 p.

Descriptors: *Ranges, *Range management, *Germination, *Temperature, Range grasses, Grasses, Arid lands, Desert plants, Vegetation establishment, New Mexico.
Identifiers: *Ground cover, Range science.

Alkali sacaton seedling germination and survival is improved by: (1) an agar medium to provide moisture for germination, (2) mulch, and (3) water on the fifth day after planting in soils containing 7 percent moisture by weight.
W70-02685

WATER REPELLENT SOILS: A WORLDWIDE CONCERN IN MANAGEMENT OF SOIL AND VEGETATION,
Forest Service, (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station.
L. F. DeBano.
Agricultural Science Review 7 (2): 11-18. Second quarter 1969.

Descriptors: *Soils, *Waterproofing, *Burning, *Soil fungi, Soil physical properties, Peat, Turf, Surfactants, Moisture availability, Erosion, Plant diseases, Organic compounds, Soil mechanics, Water conservation, California, Water harvesting, Watershed management.
Identifiers: *Water repellent soils, Wildfires, Wetting agents.

Water repellency affects the management of large areas throughout the world. Seemingly unrelated problems such as plant diseases, subsidence of peat bogs, and soil erosion may be caused by poor wettability in some situations. Organic substances produced by plants or micro-organisms can induce water repellency in soils. High soil temperatures may further intensify water repellency in areas burned by wildfires. Mechanical and chemical remedial treatments have been used to increase the wettability and productivity of these problem soils. Waterproofing soils artificially has been found beneficial for highway engineering and water harvesting purposes.
W70-02686

DESIGN OF A COMBINED SEWER FLUIDIC REGULATOR, THE DEVELOPMENT OF BASIC CONFIGURATIONS AND DESIGN CRITERIA FOR APPLICATIONS OF FLUIDS IN SEWER REGULATORS.
Bowles Engineering Corp., Silver Spring, Md.

Available from the Clearinghouse as PB-188 914, $3.00 in paper copy, $0.65 in microfiche. FWPCA Water Pollution Control Research Series, DAST-13, Oct, 1969. 137 p, 98 fig, 3 ref. FWPCA Program No 11024 DGZ.
Identifiers: *Combined sewers, Low cost, Low maintenance, *Fluidic, Regulator, *Variable diversion, No-moving-parts.

The objective of this program was to demonstrate feasibility, and to develop a workable configuration for a combined sewer Fluidic regulator, whose purpose is to minimize combined sewer discharge while protecting interceptor sewers from overloading during storm flows. A second objective was to develop design procedures and criteria for the general application of this concept to municipal sewer diversion requirements, including preliminary investigations of construction methods, costs, and maintenance requirements. A third objective was to establish a plan and location for an operational demonstration of the concept with a cooperating municipality. All objectives were successfully met. A generic Fluidic Regulator configuration was evolved which diverts 0 to 75% of the combined sewer flow away from the interceptor as a function of water level sensed in the interceptor sewer, or combined sewer, in either an analog or digital operational mode. Application design criteria were evolved for a range of small to medium sized municipal sewers, in terms of a few basic parameters. Projected installation costs are only slightly more than for conventional diversion structures; while the anticipated construction and maintenance requirements are simple and minimal. The City of Philadelphia was established as the demonstration site, and a demonstration unit should become operational in late 1970. Recommendations were made for experimental activity to improve regulation linearity; expand application size limit, and to better definitize construction methods and costs.
W70-02773

PREVENTION OF FLOOD DAMAGE.

Pa Stat Ann tit 53, secs 23169-23170 (1957).

Descriptors: *Pennsylvania, *Flood protection, *Cities, *Flood control, Control, Local governments, Water control, Flood routing, Channel improvement, Check structures, Diversion, Flood damage, Floodproofing, Flow control, Water policy, Legislation, Control systems, Rivers, Streams, Investigations.

Second class cities may provide for the cleansing, regulation and control of streams and rivers within their limits in order to prevent flood damage. Such cities may construct public works for flood prevention and may cooperate with other governmental units in such projects. This shall not restrict the jurisdiction of the Water Supply Commission. Such cities may make appropriations and expenditures for the purpose of investigating and examining the condition of such rivers and streams. (Smith-Florida)
W70-02821

WHARVES, DOCKS, AND FERRIES.
Pa Stat Ann tit 53, sec 14212-14217 (1957).

Descriptors: *Pennsylvania, *Bulkhead line, *Coastal structures, *Condemnation, Docks, Piers, Bulkheads, Local governments, Administrative agencies, Administrative decisions, Condemnation value, Cost repayment, Riparian rights, Compensation, Permits, Low water mark, Navigable rivers, Construction, Legislation.

Cities of the first class may purchase and hold all properties and improvements extending into the navigable streams in front of said cities and may remove, alter, or modify the location, dimensions, or character of same to further the commercial interests of said cities. Such action, however, shall be taken only pursuant to recommendations of the Board of Harbor Commissioners and duly enacted city ordinances. Prior to any such recommendation, the Board shall give due notice to the owners of the properties to be affected. Should the owners fail to commence the removal or reconstruction, said cities may condemn said properties and improvements upon compensating the owners. When an owner also owns the adjacent bulkhead or riparian rights, the condemnation shall only encompass the primary properties. The councils in said cities may revise and establish the line beyond which no wharf or pier may extend and establish the arbitrary low water line or bulkhead line. No license shall be granted under which a new wharf is to be built, or old wharf extended, unless afterwards there shall be a water surface between it and adjoining wharves of at least one hundred and fifty feet. (Schram-Florida)
W70-02822

WHARF LINES AT BRISTOL.
Pa Stat Ann tit 53, secs 49311-49313 (1966).

Descriptors: *Pennsylvania, *Docks, *Delaware River, *Bulkhead line, Bulkheads, Engineering structures, Piers, Rivers, Construction, Riparian rights, Riparian land, Banks, Legislation, Tidal waters, Legal aspects, Administrative agencies.

There is hereby established a wharf-line in the Delaware River at Bristol for the purpose of having a sufficient depth of water at low tide to float vessels. The burgess and council of Bristol are authorized to construct certain wharves or piers extending as far out as the wharf-line. Any owner of land fronting on the Delaware River may construct a wharf or pier to said wharf-line, subject to the authority of the Board of Wardens of the Port of Philadelphia. (Smith-Florida)
W70-02823

BIDS: RECONSTRUCTION OF DESTROYED BRIDGES.
Pa Stat Ann tit 16, sec 9305 (1956).

Descriptors: *Pennsylvania, *Bridges, *Bridge failure, *Bids, Contracts, Bridge construction, Transportation, Legislation, Governments, Costs, Cost allocation, Legal aspects.

Where delay in rebuilding will be of serious inconvenience to trade and travel, the county commissioners may reduce the time for advertisement to two weeks for bids to reconstruct destroyed bridges. (McDonough-Florida)
W70-02824

STREAM CLEARANCE, RECTIFICATION AND IMPROVEMENT.
Pa Stat Ann tit 32, secs 701-706 (1967).

Descriptors: *Channel improvements, *Pennsylvania, *Obstruction to flow, *Flood control, Mass wasting, Warning systems, Stream flow, Alteration of flow, Channels, Floods, Stream erosion, Streamflow forecasting, Stream improvement, Dams, Lakes, Impoundments, Impounded waters, Legislation, Legal aspects, Administrative agencies, Contracts, Condemnation, Easements, Dam construction.

The Department of Forests and Waters may dredge and remove flood waste, deposits, flood water obstructions and debris from any stream and may restore flood damaged stream channels in all streams except the tidal waters of the Delaware River. The Department may construct and maintain dams, lakes, and other improvements to impound flood waters, provide recreational areas, and construct flood forecasting and warning stations.

The Department may lease or purchase equipment and materials for these projects with the approval of the Governor. The Department may further acquire all property or easements necessary for carrying out this act. The Department is authorized to use condemnation proceedings for the acquisition of property. The Department is authorized, with the Governor's approval, to enter into agreements with the federal government, state agencies, or local subdivisions, municipalities, and private persons and corporations. Work assigned by the Department must be let to the lowest bidder. (Kelly-Florida)
W70-02827

DAMS AND STORAGE RESERVOIR.
Pa Stat Ann tit 32, secs 815.46-815.49a5 (1967).

Descriptors: *Pennsylvania, *Dams, *Water conservation, *Delaware River, Dam construction, Costs, Financing, Water resources development, Interstate rivers, Administration, Interstate, Operation and maintenance, Management, Impoundments, Impounded waters, Water supply, Flow augmentation, Legal aspects, Interstate compacts, New Jersey, Reservoirs, Reservoir construction, Condemnation.

The state legislature hereby accepts a portion of the New Jersey law relating to the construction of dams and reservoirs and the payment of land damages, costs, and expenses on land acquired in New Jersey for purposes of a prior act. An interstate compact is hereby entered into for the construction of a dam across a certain section of the Delaware River between New Jersey and Pennsylvania. A reservoir shall be maintained above said dam for the purpose of impounding the waters of the Delaware to provide a supply of water for domestic, commercial, and industrial purposes. Such construction and maintenance shall be deemed to be a public project for benefits of both states. Land may be taken for construction of the dam or reservoir through condemnation proceedings. Detailed procedure for condemning and/or purchasing land is provided. Certain provisions of the Delaware River Compact are revoked insofar as they prohibit construction of dams and reservoirs across the Delaware River. New Jersey and Pennsylvania mus concur on the location, size, and construction of any dam or reservoirs. (Kelly-Florida)
W70-02829

CONSERVATION AND CONTROL OF AQUATIC PLANTS AND FISH.
Wis Stat Ann secs 29.545, 29.571, 29.62, 29.623, 29.625, 29.626, 29.63 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Aquatic plants, *Fish control agents, *Regulation, Wild rice, Sago pondweed, Aquatic weed control, Administrative agencies, Harvesting, Fish hatcheries, Dam construction, Damsites, Flood control, Drainage effects, Water levels, Rough fish, Carp, Buffalo fishes, Suckers, Sport fish, Riparian land, Fish stocking, Gill nets, Trout, Permits.
Identifiers: *Wildlife refuge, *Trammel net, *Sturgeon, *Game preserve.

The removal of any aquatic plants from specified water bodies without authorization by the State Conservation Commission is prohibited. Written authorization may be given where the plants endanger public health, are not needed for propagation of fish or wildlife, or unreasonably impair property or esthetic values. A wildlife refuge is established on the Horicon Marsh. The refuge may include a fish hatchery which is to be supervised by the Commission. The Commission is authorized to construct and maintain dams to control the flood waters of Rock River and to restore the natural water levels of Horicon Marsh prior to its drainage. The Commission may remove all 'rough fish' from inland waters. It may also remove or permit the removal of any species of fish which it determines to be detrimental to any state waters or to game fish in certain designated areas. Penalties are provided for persons who use nets to catch fish in inland waters, who fish without licenses, or who otherwise violate any provision of the statutes or any Commission order related to fishing. Double damages may be awarded against trespassers on lands bordering streams stocked from state fish hatcheries. (Dearing-Florida)
W70-02838

POWERS OF THE DEPARTMENT OF RESOURCE DEVELOPMENT.

Wis Stat Ann secs 31.01, 31.02 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Water levels, *Dams, *Drainage programs, Administrative agencies, Permits, Navigable waters, Bench marks, Gaging stations, Low flow, Water measurement, Dam construction, Locks, Fish passages, Fish stocking, Chutes, Floodgates, Spillways, Hoisting machinery, Piers, Drainage districts, Ditches, Water conservation, Irrigation programs, Water birds.
Identifiers: *Pisciculture, *Marine railway, *Dykes.

The Department of Resource Development is empowered to regulate the level and flow of all navigable waters and may erect bench marks to designate the maximum and minimum levels that may be maintained by any dam. It shall establish gaging stations upon navigable waters to determine their characteristics. The Department shall investigate and supervise the construction, operation, and maintenance of all dams in navigable waters. The Department shall have free access to any dam and may enter any property to investigate a waterway or the use of water from any lake or stream. The Department may require any dam to be furnished with log slides and chutes, locks, boat hoists, or other special equipment set forth in the statute. The Conservation Commission shall operate and maintain dams and dikes across drainage ditches and streams in drainage districts. (Dearing-Florida)
W70-02842

4B. Groundwater Management

FUTURE OF GROUND WATER IN AFRICAN SAHARA DESERT,
Alexandria Univ. (Egypt). Faculty of Engineering.
For primary bibliographic entry see Field 02F.
W70-02452

SALT-WATER ENCROACHMENT INTO AQUIFERS.
For primary bibliographic entry see Field 02L.
W70-02484

THE HYDROGEOLOGIC SETTING IN LOS ANGELES COUNTY, CALIFORNIA,
Los Angeles County Flood Control District, Calif., Water Conservation Div.
For primary bibliographic entry see Field 02L.
W70-02490

THE AMELIORATION OR PREVENTION OF SALT-WATER INTRUSION IN AQUIFERS - EXPERIENCE IN LOS ANGELES COUNTY, CALIFORNIA,
Los Angeles County Flood Control District, Calif.
For primary bibliographic entry see Field 02L.
W70-02491

UNDERGROUND WATER DEVELOPMENT.
For primary bibliographic entry see Field 06E.
W70-02530

RATE AND DIRECTION OF GROUNDWATER CIRCULATION IN CLOSE SPACED BEDROCK AND GRAVEL WELLS UNDER NON-SYNCHRONOUS PUMPING TIME AND RATES,
Connecticut Univ., Storrs. Inst. of Water Resources.
L. Frankel.
Research Project Technical Completion Report, 1969. 4 p. OWRR Project A-005 (CONN).

Descriptors: Glaciolacustrine, *Sedimentation, Sorting, *Grain size, Glaciofluvial.
Identifiers: Hydrology, Groundwater, *Water supply, Contamination, *Water yield.

Two low yield well fields were developed in the complexly bedded glaciolacustrine and glaciofluvial materials of the Skungamaug River Valley. Textural analyses, measurement of flow patterns in close spaced wells and observations of well reactions to various tests suggest that the individual beds and lenses of sediment vary so greatly in their hydrologic characteristics that they constitute not a single aquifer but a complex of intermingled aquifers of limited horizontal and vertical extent. As a result of this complex, varying and presently unpredictable degrees of interaction exists among these sedimentary units within the system. The complex cannot be evaluated as a single, uniform system. In addition, it appears from the test performed, that the total grain size distribution characteristics of each sedimentary unit have a greater relationship to the hydrology of the unit than average grain size values of these units.
W70-02735

RELATION OF BEDROCK FRACTURE SYSTEMS TO UNDERGROUND WATER SUPPLIES IN THE STAFFORD SPRINGS, SOUTH CONVENTRY, SPRING HILL, AND WESTFORD QUADRANGLES,
Connecticut Univ., Storrs.
For primary bibliographic entry see Field 02F.
W70-02756

4C. Effects on Water of Man's Non-Water Activities

URBAN RUNOFF BY ROAD RESEARCH LABORATORY METHOD,
Illinois State Water Survey, Urbana.
Michael L. Terstriep, and John B. Stall
ASCE Proc, J Hydraul Div, Vol 95, No HY6, Pap 6878, p 1809-1834, Nov 1969. 26 p, 19 fig, 6 tab, 19 ref, append.

Descriptors: Storm runoff, *Urbanization, Mathematical models, Rainfall-runoff relationships, Roads, Model studies, Storm drains, Hydraulics, Hydrology, Open channel flow, Sewers, Streamflow, Planning
Identifiers: Urban hydrology, Urban planning.

A simple mathematical model of an urban basin presented in 1962 by the British Road Research Laboratory is tested on three urban watersheds in the United States. The basins are located in Baltimore, Md. and Chicago, and Champaign, Ill. They contain 0.395, 12.5, and 2290 acres respectively. The model produces a runoff hydrograph by applying rainfall to only the directly connected impervious area of the basin. The basin is described by a time-area diagram and a discharge-storage relationship. The peak discharges of actual and predicted hydrographs are compared for 39 storms and complete hydrographs are shown for 8 of these. To apply the model to a basin, the pattern of impervious areas must be known in detail, as well as the slopes and sizes of all surface and subsurface drains. (Knapp-USGS)
W70-02467

SALT-WATER ENCROACHMENT INTO AQUIFERS.
For primary bibliographic entry see Field 02L.
W70-02484

COMBATING SALT-WATER ENCROACHMENT INTO THE BISCAYNE AQUIFER OF MIAMI, FLORIDA,
Dade County Engineering Dept., Miami, Fla.
For primary bibliographic entry see Field 02L.
W70-02485

SALT-WATER INTRUSION IN SOUTHEASTERN FLORIDA,
Central and Southern Florida Flood Control District, West Palm Beach, Fla.
For primary bibliographic entry see Field 02L.
W70-02486

PROTECTING LONG ISLAND AQUIFERS AGAINST SALT-WATER INTRUSION,
New York State Dept. of Conservation, Albany. Div. of Water Resources.
For primary bibliographic entry see Field 02L.
W70-02488

A DECADE, RESEARCH IN LAND AND WATER MANAGEMENT, 1957-1967,
Institute for Land and Water Management Research, Wageningen (Netherlands).
For primary bibliographic entry see Field 06B.
W70-02495

BAER V BD OF COUNTY COMM'RS OF WASHINGTON COUNTY.

257 A2d 201-205 (Ct App Md 1969).

Descriptors: *Maryland, *Alteration of flow, *Riddance (Legal aspects), *Relative rights, Pipes, Drains, Drainage, Surface waters, Subsurface waters, Water control, Drainage water, Legal aspects, Judicial decisions, Surface runoff, Drainage systems, Drainage effects, Running waters, Groundwater, Groundwater movement, Repulsion (Legal aspects), Land tenure, Absorption, Diversion, Inhibition, Rainwater.
Identifiers: Injunction (Prohibitory).

Washington County, through the use of pipes, channeled water from higher adjacent lots to a point near the lot of a lower owner. As a result the lower owner was deprived of the natural processes of absorption and diversion. Substantial quantities of water accumulated on the lower owner's lot after heavy rains, and the lower owner sought injunctive relief. The lower court dismissed the owner's complaint. On appeal, the Court of Appeals of Maryland remanded the case, holding that while a servient estate is required to accept water from higher adjacent lots, the upper proprietor must act reasonably. (Marsee-Florida)
W70-02517

SOME ASPECTS OF THE EFFECTS OF THE QUANTITY AND QUALITY OF WATER ON BIOLOGICAL COMMUNITIES IN EVERGLADES NATIONAL PARK,
Geological Survey, Miami, Fla. Water Resources Div.
Milton C. Kolipinski, and Aaron L. Higer.
Geological Survey Open file Report, Sept 1969. 97 p, 21 fig, 8 tab, 25 ref.

Descriptors: *Water quality, *Water levels, *Streamflow, *Florida, *Wetlands, Swamps, Surface waters, Ecology, Droughts, Water pollution sources, Dissolved oxygen, Sampling, Drought resistance, Hydrology, Low flow.
Identifiers: *Everglades, *Shark River.

Hydrobiological investigations were made in Everglades National Park and are summarized under four main topics: (1) vegetative changes, (2) population dynamics of animals, (3) repopulation of small aquatic animals after droughts, and (4) water-quality characteristics. Changes of vegetation in Shark River Slough from 1940 to 1964 showed a decrease in acreage of wet prairie communities and an increase in sawgrass marshes and woody vegetation. The apparent reasons for the changes are shortened wet periods, increase in fires, and loss of soil. Long wet periods result in an abundance of small aquatic animals and the successful formation of wading bird rookeries. (Knapp-USGS)
W70-02631

SOME EFFECTS OF CLEARCUTTING ON SALMON HABITAT OF TWO SOUTHEAST ALASKA STREAMS,
Forest Service (USDA), Juneau, Alaska. Pacific Northwest Forest and Range Experiment Station.
W. R. Meehan, W. A. Farr, D. M. Bishop, and J. H. Patric.
USDA Forest Serv Res Paper PNW-82, 1969. 45 p, 18 tab, 15 fig, 69 ref.

Descriptors: *Clearcutting, *Salmon, *Water quality, *Aquatic habitats, Alaska, Water temperature, Sedimentation, Streamflow, Lumbering.
Identifiers: *Spawning streams, Channel debris, Log-debris jams.

The effects of clearcutting on streamflow, suspended sediment, stream temperature, log-debris jams, and indirectly on salmon populations of two watersheds were evaluated and compared with an uncut watershed in southeast Alaska. Although some effects were observed, the timber harvest did not appear harmful to salmon habitats or populations. (Helmers-Forest Service)
W70-02724

4D. Watershed Protection

SOIL CONSERVATION POLICY.

Pa Stat Ann tit 55, sec 850 (1963).

Descriptors: *Pennsylvania, *Soil conservation, *Soil erosion, *Erosion control, Flood control, Legislation, Legal aspects, Natural resources, Dams, Reservoirs, Navigation, Rivers, Harbors, Public health, Wildlife conservation.
Identifiers: *Public policy, Public welfare.

It is the declared policy of the state to provide for the conservation of soil and soil resources and for the control and prevention of soil erosion in order to preserve natural resources, assist in flood control, prevent impairment of dams and reservoirs, assist in maintaining the navigability of rivers and harbors, preserve wildlife, preserve the tax base, protect public lands, and protect and promote the health, safety and general welfare of the people of the state. (Keith-Florida)
W70-02521

REFORESTATION SURVEY.

Pa Stat Ann tit 32, secs 673-677 (1967).

Descriptors: *Pennsylvania, Surveys, *Investigations, *Flood control, Administrative agencies, Natural resources, Data collections, On-site investigation, Land resources, Conservation, Land use, Water resources, Water resources development, Legal aspects, Legislation, Reforestation, Forest management, Land development, Land management.

The Department of Forests and Waters is authorized to make an investigation and reforestation survey, with flood control as the objective, of the three watersheds of the Commonwealth. The investigation and survey are to be made of all private lands and all abandoned farm lands and submarginal lands. The Department shall make a complete report of its reforestation survey to the General Assembly, so that the General Assembly may be advised regarding adoption of a comprehensive flood control program. Whenever any grant or right in the bed of any navigable waters in the Commonwealth becomes inimical to the public interest, it shall be voided. The Department is empowered to determine when any such right, grant or privilege has become derogatory or inimical to the public interest. A full hearing with due notice is required before such finding may be made. Appeals may be made by aggrieved parties to the Superior Court. (Kelly-Florida)
W70-02532

UNITED STATES PROJECTS.
For primary bibliographic entry see Field 06E.
W70-02533

RANGE SEEDING PROBLEMS AND RESEARCH IN THE PINYON-JUNIPER WOODLAND TYPE OF SOUTHWESTERN UNITED STATES,
Agricultural Research Service, Washington, D.C. Crop Research Div.
F. B. Gomm, and Fred Lavin.
Annals of Arid Zone, Vol 7, No 2, p 209-220, 1968. 1 fig, 35 ref.

Descriptors: *Southwest U.S., *Pinyon pine trees, *Juniper trees, *Range management, *Semiarid climates, Brush control, Grazing, Droughts, Land use, Grasses, Rehabilitation, Planting management, Natural resources, Vegetation, Carrying capacity, Economics, Costs, Ecology, Decision making, Rainfall, Seeds, Forests, Forages, Range grasses, Revegetation.
Identifiers: *Reseeding.

Pinyon-juniper woodland is used primarily for spring and fall grazing. Use of juniper wood for fuel and fence posts has declined to the point that juniper is now considered a weed species. These lands have been traditionally over grazed, and now have an average stocking rate of 7 acres per animal-unit-month (AUM). In areas where range improvement is economically justified, it is often necessary to kill trees before planting forage grasses. Pinyon-juniper woodlands cover about 60 million acres in the Southwest. The climate is semiarid and subject to frequent droughts. Potential economic returns from livestock must be weighed against costs of controlling pinyon and juniper and reseeding before a decision can be made regarding a particular area. A thorough study of the ecological conditions is recommended as a preliminary step necessary to decision making and choice of species to be reseeded. A list of potentially useful forage species is given. (Crouse-Arizona)
W70-02555

HYDROGRAPHIC AND SEDIMENTATION SURVEY OF KAJAKAI RESERVOIR, AFGHANISTAN,
Geological Survey of Afghanistan, Kabul. Water Resources Div.
For primary bibliographic entry see Field 02J.
W70-02669

SOME EFFECTS OF CLEARCUTTING ON SALMON HABITAT OF TWO SOUTHEAST ALASKA STREAMS,
Forest Service (USDA), Juneau, Alaska. Pacific Northwest Forest and Range Experiment Station.
For primary bibliographic entry see Field 04C.
W70-02724

EROSION PREVENTION EXPERIMENTS,
Connecticut Univ., Storrs.
Chesley J. Posey.
Proc 13th Congr Intn'l Assoc for Hydr Res, Vol 2, p 211-219, 1969. OWRR Project A-009-CONN.

Descriptors: *Erosion control, Stream stabilization, Groundwater replenishment.
Identifiers: *Riprap, *Reverse filters, Rock sausages, Gabions.

Test of erosion protection in model channels, in an apparatus designed to permit comparisons under severe erosion exposure, and in field installations show that successive layers, each meeting the specifications for reverse filters will give complete protection to the finest, most erodible soils. Accurate prediction of the sizes necessary for the topmost layer, to prevent it from being washed away, cannot be made, and this must be determined by trial. If large enough stones are not available, smaller stones may be bound with mesh tubing, giving greatly increased resistance to erosion. Observations of field installations are being continued under auspices of the Connecticut Department of Transportation. A 16 mm silent color motion picture film summarizes the results obtained so far in form suitable for showing to engineering designers and maintenance men.
W70-02730

STATE V ARCHER.

107 NJ Super 77, 257 A2d 1-2 (1969).

Descriptors: *New Jersey, *Eminent domain, *Erosion control, *Condemnation, Judicial decisions, Hurricanes, Beach erosion, Beaches, Streams, Erosion, Coastal engineering, Shore protection, Soil erosion, Tidal effects, Waves (Water), Public lands, Legislation, Legal aspects, Projects, Federal government, State governments, Water law.

A New Jersey statute authorized the Department of Conservation and Economic Development to condemn lands for improvement or development of waterways, streams, rivers, creeks, or waterfront or oceanfront property. The Department took lands in the Borough of Union Beach for purposes of hurricane and shore protection in conjunction with a federal project for beach erosion control and hurricane protection. The Superior Court of New Jersey, Appellate Division, held that the taking was authorized by the statute, and that such taking was for public purpose, though the program necessarily affected only particular areas. (Marsee-Florida)
W70-02834

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

RESPIRATION CORRECTIONS FOR BACTERIAL UPTAKE OF DISSOLVED ORGANIC COMPOUNDS IN NATURAL WATERS,
North Carolina State Univ., Raleigh. Dept. of Zoology.
John E. Hobbie, and Claude C. Crawford.
Limnology and Oceanography, Vol 14, No 4, p 528-532, July 1969. 5 p, 2 fig, 2 tab, 8 ref. OWRR Project A-015-NC, and NSF Grant GB-5678.

Descriptors: *Respiration, *Bacteria, *Radiochemical analysis, *Organic compounds, Microorganisms, Carbon dioxide, Ponds, Sampling, Analytical techniques, Plankton, Carbon radioisotopes, Tracers, Tracking techniques.
Identifiers: Carbon-14 analysis.

The uptake of C-14 labeled organic compounds has been used by many workers to study heterotrophic microorganisms in natural waters. However, if flux rates of organic compounds are to be measured, the loss of carbon dioxide during incubation becomes an important source of error. A method is proposed in which the experiment is run in a closed system and the carbon dioxide collected after killing and acidification. Phenethylamine on chromatographic paper is the absorbing agent and the paper is counted by liquid scintillation. Studies of 19 compounds from pond water showed that 60% (aspartic acid) to 8% (arginine) of the labeled material entering the microorganisms was respired. (Gabriel-USGS)
W70-02641

ALKALINITY BUDGET OF THE COLUMBIA RIVER,
Oregon State Univ., Corvallis. Dept. of Oceanography; Federal Water Pollution Control Administration, Washington, D.C. Div. of Engineering Development; and Idaho Univ., Moscow. Dept. of Chemistry.
For primary bibliographic entry see Field 02K.
W70-02642

LIMITATION OF ALGAL GROWTH IN SOME CENTRAL AFRICAN WATERS,
Malawi Univ., Limbe.
For primary bibliographic entry see Field 05C.
W70-02646

INTERACTION OF PESTICIDE POLLUTANTS AND AQUATIC FOOD-CHAIN ORGANISMS,
Clemson Univ., S.C.
For primary bibliographic entry see Field 05C.
W70-02677

EFFECT OF BORON ON BIOLOGICAL WASTE TREATMENT,
Delaware Univ., Newark. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05D.
W70-02734

STUDIES ON PHOSPHOROUS TRANSFORMATIONS IN EUTROPHIC LAKES,
Connecticut Univ., Storrs.
For primary bibliographic entry see Field 05C.
W70-02747

INTERACTION OF INORGANIC AND ORGANIC FERTILIZER MATERIALS WITH PESTICIDES AS RELATED TO WATER QUALITY IN SOILS,
Arkansas Univ, Fayetteville. Dept. of Agronomy.
For primary bibliographic entry see Field 05B.
W70-02761

ANALYSIS OF TRACE ELEMENTS IN WATER,
Rhode Island Univ., Kingston. Water Resources Center.
Vincent C. Rose.
Technical Completion Report 1969. 8 p. OWRR Project A-019-RI.

Descriptors: *Pollution, *Trace metals, *Ion exchange, *X-ray fluorescence.
Identifiers: *Nuclear fuel.

The purpose of this research was to develop ion exchange techniques for rapidly concentrating certain trace metals from water and to develop methods of analyzing the samples on ion exchange media. The study was limited to uranium, zirconium, tin, nickel, chromium and iron. Cation exchanger load filter papers were used to concentrate the solutions using a flow rate of 23 ml/sq cm/min. The fluid was recycled through the paper six times. The papers were analyzed by x-ray fluorescence analysis. As little as 25 micrograms of metal gave a statistically valid signal. A linear relation between normalized count rate and the amount of metal was found. The lower analytical detection limit was 0.125 milligram or all elements and the upper limit (98% recovery) ranged from 0.6 milligrams for chromium to 1.25 milligrams for uranium.
W70-02768

BIOASSAY OF WATER POLLUTANTS WITH CULTURED MAMMALIAN CELLS,
Rhode Island Univ., Kingston. Dept. of Biophysics.
Harold W. Fisher.
Technical Completion Report, Rhode Island Water Resources Center, 1969. 13 p, 1 tab, 11 fig. OWRR Project A-027-RI.

Descriptors: *Bioassay, *Pollutants, *Mammalian cells.

Plating efficiency tests of the growth of discrete macroscopic colonies from single cells of cultures of human and bovine cells were used to titrate the toxicity of various inorganic pollutants, herbicides and pesticides. Significant differences were found for the titration end-points of the test substances and a high degree of sensitivity to some of them was revealed. One of the most toxic pesticides, Rotenone (C23H22O6) was analyzed by exposing single attached cells in the petri dish to selected concentrations of the pesticide for different lengths of time, then removing the pesticide and growing the surviving cells in fresh complete growth medium. A plot of the log of the surviving fraction as a function of exposure time gave a straight line at each concentration tested. The slopes of these lines as a function of the respective concentration of pesticide also gave a straight line passing through the origin. This suggests that perhaps there is no threshold for the toxicity of some water pollutants.
W70-02771

PROCEEDINGS OF THE EUTROPHICATION-BIOSTIMULATION ASSESSMENT WORKSHOP.
California Univ., Berkeley. Sanitary Engineering Research Lab and Pacific Northwest Water Lab, Corvallis, Oreg.

Proceedings of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ, Berkeley, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Oregon, Pacific Northwest Water Lab p i-iv + 281 p, 93 fig, 43 tab, 341 ref.

Descriptors: Eutrophication, *Conferences, Water pollution effects, Algal control, Water pollution, Toxicity, Lakes, Design criteria, Remote sensing, Minnesota, Sediment-water interfaces, California, Bioassay, Scenedesmus, Physiological ecology, Kinetics, Farm wastes, Benthos, Nitrates, Fluorescence, Nitrogen fixation, Environmental effects, Nutrient requirements, Communities (Biological), Carbon radioisotopes, Productivity, Rivers, Trace elements.
Identifiers: *Biostimulation, Algal growth, Water pollution assessment, Sanitary Engineering Research Laboratory (Calif), National Eutrophication Research Program, Continuous culture, Chemostats, Batch cultures, Acetylene reduction technique, Heterotrophy, Flagellates, Lake classification, Shagawa Lake (Minn).

Eutrophication may be the most serious and pressing water quality problem we face, and new scrutiny of research approaches is required. The deliberations are presented of a group of workers in eutrophication held at Berkeley, California, during 19-21 June 1969. The sessions were sponsored by the Sanitary Engineering Research Laboratory, University of California, and the National Eutrophication Research Program, US Department of the Interior. Scope of the report is indicated by subjects of individual contributions: need for assays, chemostat assays, batch assays for determining algal growth potential; algal growth assessment by fluorescence techniques; kinetic assessment of algal growth, factors in utilization by Scenedesmus of nitrate from agricultural wastes; environmental and nutritional requirements for algae; assessment of nitrogen fixation by acetylene reduction, heterotrophy in algal flagellates, physiological ecology, physiological ecology of benthic algal communities; measurement of algal growth with radiocarbon; lacustrine classification; productivity of rivers; measurement of trace elements in the hydrosphere; design applications of biostimulation

and toxicity criteria; remote sensing in water resources management; nutrient exchange between sediment and water; and Shagawa Lake (Minnesota) eutrophication research project. An index is provided. See also W70-02776 thru W70-02779). (Eichhorn-Wisconsin)
W70-02775

NEED FOR ASSAYS,
California Univ., Berkeley. Sanitary Engineering Research Lab; and Pacific Northwest Water Lab. Corvallis, Oreg.
Gerard A. Rohlich.
Proceedings of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ, Berkeley, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Oregon, Pac Northwest Water Lab, p 1-6. 1 fig, 6 ref.

Descriptors: *Bioassays, *Eutrophication, Nutrients, Water pollution sources, Limnology, Comparative productivity, Environmental effects, Water pollution effects, Planning, Water quality, Analytical techniques.
Identifiers: Provisional Algal Assay Procedure, Joint Industry/Government Task Force on Eutrophication, Norway, Algal cultures, Algal growth, Water pollution assessment, Comparative studies, Water quality criteria, Standardization, Reproducibility, Research planning.

Because millions of dollars in public funds will, in the next few years, be expended to implement programs for the control of nutrients received by natural waters, scientists and engineers should work toward establishment of bioassays which will give comparable and reproducible results. Some experience in use of such assays has been gained in Norway. A standazrdized bioassay should serve to: (1) assess available algal nutrients in absence of toxicants; (2) estimate the effect on algal growth of added stimulants; and (3) determine acceptable levels for reduction of algal nutrients in any given body of water. The Provisional Algal Assay Procedure proposed by the Joint Industry/Government Task Force on Eutrophication is intended to meet those needs. (See W70-02775). (Eichhorn-Wisconsin)
W70-02776

ALGAL GROWTH ASSESSMENTS BY FLUORESCENCE TECHNIQUES,
Federal Water Pollution Control Administration, Alameda, Calif.
Richard C. Bain, Jr.
Proc of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ, Berkeley, Sanitary Engineering Research Lab and Nat Eutrophication Research Program, Corvallis, Ore, Pac Northwest Water Lab, p 39-55. 9 fig, 20 ref, append.

Descriptors: *Algal growth, *Bioassays, *Fluorometry, California, Nutrients, Eutrophication, Chlorophyll, Fluorescence, Lakes, Rivers, Nitrogen, Biomass, Sewage, Farm wastes, Carbon cycle, Phosphorus, Phosphate, Nitrates, Industrial wastes, Water pollution effects, Denitrification, Spectrophotometry.
Identifiers: San Joaquin River (Calif), Merced River (Calif), Tuolumne River (Calif), Stanislaus River (Calif), Water pollution assessment, American River (Calif), Clear Lake (Calif), Eel River (Calif), Joint Industry/Government Task Force on Eutrophication, Provisional Algal Assay Procedure, Batch cultures, Chemostats, Chlorophyll a, Photobiology, Algal growth potential, San Francisco Bay.

Author describes procedures for assessing algal growth potential, in Joint Industry/Government Task Force's Provisional Algal Assay Procedure, by estimating algal chlorophyll fluorometrically or spectrophotometrically. Water smaples are filtered through glass fiber filters, preserved with magnesium carbonate, and filters kept frozen in dark refrigerator. Chlorophyll concentration, extracted into solution by grinding the filter in acetone, is estimated by spectrophotometry (at wavelengths 630, 645 and 665 nanometers) or fluorometry. Correction for phaeophytin is accomplished by a second reading after treatment of sample with hydrochloric acid. Illustrative data for various California waters receiving sewage, agricultural, and industrial wastes are delineated in the report. In batch assays, peak fluorescence due to chlorophyll, characteristically appears within the first week, not necessarily paralleling peak biomasses. Data analysis from such assays together with those for nutrient analysis permits interpretive applications of the procedure. Thus, for 44 data points from various streams in San Joaquin Valley, in which nitrogen is thought to be limiting, regression analysis of relationship between total N (milligrams/liter) and chlorophyll (micrograms/liter) yields ratio, total N/chlorophyll, with 95% confidence interval of 4.6-10.8, in good agreement with literature values for algal cells with nitrogen limiting. (See W70-02775). (Eichhorn-Wisconsin)
W70-02777

BATCH ASSAYS FOR DETERMINATION OF ALGAL GROWTH POTENTIAL,
California Univ., Berkeley. Sanitary Engineering Research Lab.
William J. Oswald, and Suresh A. Gaonkar.
Proc of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ, Berkeley, Sanitary Engineering Research Lab and Nat Eutrophication Research Program, Corvallis, Ore, Pac Northwest Water Lab, p 23-38. 8 fig, 13 ref.

Descriptors: *Cultures, *Algae, Eutrophication, Water pollution effects, Iron, Chlorella, Bioassays, Bioindicators, Activated sludge, Nutrients, Phosphorus, Nitrogen, Gravimetry, Spectrophotometry, Carbon radioisotopes, Centrifugation, Fluorometry, Volumetric analysis, Chlamydomonas, Toxicity, Euglena, Waste treatment.
Identifiers: *Batch assays, *Algal growth potential, Water pollution assessment, Pacific Northwest Laboratory, Provisional Algal Assay Procedure, Bottle tests, Phacus, Limiting factors, Synergism, Temperature effects, Selenastrum capricornutum, Photobiology, Anabaena flos-aquae, Microcystis aeruginosa, Scenedesmus obliquus, Pleomorphism, Cell size, Error analysis, Cell enumeration.

Successful use of algal cultures in studies of algal growth potentials, trace mineral analyses, tastes and odors, and toxicity, gives reason to believe they may be valuable for assessment of eutrophication potential in the 'bottle test' version of the Provisional Algal Assay Procedure (PAAP), as proposed by the National Eutrophication Research Program. While tests may lack elegance, they are simple, flexible, versatile, reliable, and applicable--criteria established as desirable for that program. Author feels that certain characteristics of the test, as presently recommended, require alteration. It is doubtful, for example, if requirements for vigorous shaking, rigid temperature control, and accessory gases are necessary. In addition, simplified incubation techniques and apparatus should be evaluated. Several of the techniques proposed for assessment of growth in cultures may be unnecessarily complex or expensive, whereas techniques of fluorescence analysis and volumetric analysis of growth--not now being considered--should be studied. Parameters of growth in PAAP could be evaluated in terms of growth levels for which they may be most useful; thus, a rational system might involve enumeration of cells for algal growth potentials (in milligrams/liter) of 0.1-10; fluorescence, for 10-100; and gravimetry, for 100-1000. (See W70-02775). (Eichhorn-Wisconsin)
W70-02778

CONTINUOUS-FLOW (CHEMOSTAT) ASSAYS,
California Univ., Berkeley. Sanitary Engineering Research Lab
Donald B. Porcella.
Proceedings of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ, Berkeley, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Ore, Pacific Northwest Water Lab, p 7-22. 6 fig, 1 tab, 30 ref.

Descriptors: *Bioassays, Nutrients, Phosphorus, Kinetic theory, Environmental factors, Biomass, Growth rates, Algae, Oligotrophy, Limiting factors, Chlorella, Analytical techniques, Cyanophyta, Diatoms, Eutrophication, Water pollution effects, Systems analysis, Succession, Ecosystems, Cycling nutrients.
Identifiers: *Continuous culture, *Chemostats, Turbidostats, Nutrient limited growth, Luxury consumption, Provisional Algal Assay, Procedures, Selenastrum capricornutum, Selenastrum gracile, Growth limitation, Selenastrum, Algal growth, Anabaena, Biostimulation, Water pollution assessment.

Because their dynamic properties more nearly approximate ecological conditions than do batch cultures, continuous cultures operating in chemostat mode (constant flow-rate) have been utilized in a variety of studies of algal growth, including assessment of biostimulatory responses. Requirements for steady state continuous flow systems and characteristics of ideal chemostats with illustrations of idealized curves from an experiment concerning relative change in algal cell material and limiting phosphorus concentrations are included. In transient phases of chemostat operation, phosphorus concentrations are less than those calculated theoretically, probably due to 'luxury consumption' by algae. Considerations of mass balances and kinetics of algal growth, useful in derivation of continuous cultures theory, need be applied to natural ecosystems to elicit useful information on productivity, nutrient cycling, and successional relationships. Based on chemostat experiments described, utilizing both Selenastrum gracile and natural algal populations as 'seed', are areas requiring further study, including the following problems: multiple limiting factors; use of natural 'seed' populations, excessive washout and extinction of cultures in bioassay of oligotrophic waters, development of synthetic media; and profiles of biomass analysis and nutrient concentration during transient growth in order to establish appropriate kinetic parameters. (See W70-02775). (Eichhorn-Wisconsin)
W70-02779

MEMBRANE FILTER-FLUORESCENT-ANTIBODY METHOD FOR DETECTION AND ENUMERATION OF BACTERIA IN WATER,
North Texas State Univ., Denton. Dept. of Biology.
Rufus K. Guthrie, and Dennis J. Reeder.
Applied Microbiology, Vol 17, No 3, p 399-401, Mar 1969. 1 fig, 1 tab, 8 ref.

Descriptors: *Bacteria, *Coliforms, *Fluorescence, *Technical feasibility, Water pollution sources, Water pollution.
Identifiers: *Technique, Membrane filter methods, Fecal pollution, Escherichia coli, Fluorescent-antibody techniques.

The best currently available standard method for enumerating coliform bacteria (indicators of fecal pollution, and thus potentially endangering waters) requires from 18-24 hours for completion. An application of the fluorescent antibody technique to coliform detection and counting requires only 5-12 hours for completion. In this new application, the sample of water being tested was pulled through a black, gridded membrane filter, and incubated on Trypticase Soy Agar. After incubation at 35 C the membrane was placed back on the filter apparatus, overlayed with normal rabbit serum, and allowed 5 minutes contact. This was then pulled through by negative pressure. Next, the colonies were overlayered with specific or pooled labeled antiserum, given 15-20 minutes contact, then pulled through. After washing with buffered saline and glycerol solution, colonies were counted with a ten-power

dissecting microscope rigged for fluorescence observation. Coliform counts using the new technique compared favorably with standard MPN and m-Endu and m-FC techniques. (Gerhold-Wisconsin)
W70-02782

INTERPRETATION OF RADIONUCLIDE UPTAKE FROM AQUATIC ENVIRONMENTS,
Oak Ridge National Lab., Tenn. Radiation Ecology Section.
Daniel J. Nelson.
Nuclear Safety, Vol 5, No 2, p 196-199, 1964. 12 ref.

Descriptors: *Radioisotopes, *Aquatic environment, Chlorella, Tracers, Photosynthesis, Carbon radioisotopes, Fish, Clams, Strontium radioisotopes, Tennessee River, Trophic level, Algae, Caddisflies, Food chains, Stable isotopes, Radioactive waste disposal, Oceans, Foods, Absorption, Hazards, Cesium, Hydrogen, Deuterium, Tritium.
Identifiers: *Uptake, Specific activity, Chlorella pyrenoidosa, Biological half-life, Clinch River (Tennessee), Physical half-life, Hydropsyche cockerelli, Body burdens, Pomoxis annularis, Gastrointestinal tract.

Specific activities in aquatic organisms help explain differences in radionuclide uptake. Data evolved by routine radiological monitoring establishes safety standards for radionuclide releases to freshwater habitats. Equilibrium levels of radionuclides between organisms and environment are expected only for elements with short biological half-life in tissue. Method of specific activities is based on assumption that if the distribution of a stable element is known between an organism and its environment, it may be used to predict radionuclide concentrations in water organisms receiving constant radionuclide releases. The relation of strontium and strontium-90 in fish may be used to calculate expected body burdens. Specific activity relation might be a criterion for limiting radioactive waste disposal in oceans. While specific activity of a chemical element in environment of human food organisms is below the permissible specific activity for the element in a human body, man cannot obtain more than his permissible body burden from the seas. Direct application of the specific activity concept applies only to those radionuclides which constitute an absorption hazard. With radionuclides for which absorption is not critical, specific activities may be related to irradiation of the gastrointestinal tract by its contents. (Jones-Wisconsin)
W70-02786

SIMULTANEOUS DETERMINATION OF Zn-65-30 AND P-32-15 IN SHELLFISH BY RADIOCHEMCIAL TECHNIQUES,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Lab. of Physical and Engineering Sciences.
J. L. Setser, and T. C. Rozzell.
Talanta, Vol 12, p 903-911, 1965. 3 tab, 14 ref.

Descriptors: *Zinc radioisotopes, *Phosphorus radioisotopes, *Shellfish, *Radiochemical analysis, Clams, Oysters, Crabs, Anion exchange, Resins, Radioactivity, Precision tests, Chromium, Iron, Cobalt radioisotopes, Potassium radioisotopes, Strontium radioisotopes, Cesium, Manganese, Arsenic radioisotopes, Sodium, Oregon, Water pollution effects, Water pollution sources, Radioecology.
Identifiers: *Water pollution identification, Matrix methods, Sensitivity, Mercury radioisotopes, Ruthenium radioisotopes, Zirconium radioisotopes, Niobium radioisotopes, Yttrium radioisotopes, Tillamook Bay (Oregon), Spectrum stripping methods, Half-life.

Zn-65 (radiozinc) and P-32 (radiophosphorus) are created by neutron activation in single-pass water-cooled reactors. The usual procedure in such reactors involves circulation of river water, after removal of suspended materials by water treatment as coolant, around and through the reactor, and after several hours, returning the heated water to the river. A radiochemical procedure for rapid determination of Zn-65 in shellfish is described. Because of interest in both Zn-65 and P-32, the procedure was combined with a classical phosphorus procedure and made compatible for simultaneous determination of the two nuclides. The method described is far less expensive than matrix or spectrum stripping procedures of determination, and has been applied to pure samples consisting only of Zn-65 and P-32, and to unknown samples consisting of a complex organic matrix. Tests for sensitivity, precision, and accuracy indicate the technique has direct application to determination of the two nuclides in shellfish analyzed over a period of eight months. Radiochemical values agreed reasonable well with data from two separate matrix methods and with data for both nuclides reported by other investigators. (Jones-Wisconsin)
W70-02796

SEDIMENTARY PHOSPHORUS IN LAKE CORES--ANALYTICAL PROCEDURE,
Wisconsin Univ., Madison. Water Chemistry Lab.
Dennis A. Wentz, and G. Fred Lee.
Environmental Science and Technology, Vol 3, No 8, p 750-754, Aug 1969. 3 fig, 4 tab, 24 ref.

Descriptors: *Phosphorus, *Sediments, *Lakes, *Cores, *Chemical analysis, Nutrients, Eutrophication, Soil chemistry, Water chemistry, Sorption, Water pollution sources, Spectrophotometry, Hydrogen ion concentration, Phosphorus compounds, Iron.
Identifiers: *Water pollution identification, Water pollution assessment, Beer's law, Extraction procedures, Sample size, Orthophosphates, Phosphorus (Available), Fluoroapatite, Error analysis, Precision, Calcium phytate, Sample pretreatment, Adenosine monophosphate, Iron interference, Ferric phosphate, Sensitivity.

Available P (phosphorus) is an operationally defined fraction of soil influencing plant growth response. Procedures are described for extracting available P from sediments utilizing dilute mixture of hydrochloric and sulfuric acids. Size and pretreatment of sample, and pH of sediment-extractant mixture significantly affect amounts of P extracted. At pH employed, all sorbed orthophosphates should leach from sediments. Of fluoroapatite and calcium phytate added to samples, 88 and 11% respectively were recovered; adenosine monophosphate and ferric phosphate were not recoverable. Iron (22.3 milligrams iron/gram dry sediment) did not interfere. Relatively constant but significant errors result from turbidity and color leaching from sediment. Conversion to vanadomolybdophosporic derivative yields yellow solution which is estimated spectrophotometrically at wavelength, 420 nanometers, which minimizes effects of iron, guarantees optimal sensitivity, and insures adherence to Beer's law. Five samples each at three concentrations (10.0, 2.00, and 1.00 milligrams P/liter), and three optical path lengths (1, 5, and 10 centimeters), yield following ranges of sensitivity (S--milligrams P/liter per 1% transmittance), precision (C--standard deviation of replicately measured concentrations), and working range (W--milligrams P/liter): S, 0.015-0.15; M, 0.02-0.2; C, 0.002-0.02; and W, 0.2-18. The technique has application in studies of accelerated eutrophication. (Eichhorn-Wisconsin)
W70-02801

5B. Sources of Pollution

LEAD AND OTHER METAL IONS IN UNITED STATES PRECIPITATION,
National Center for Atmospheric Research, Boulder, Colo. Atmospheric Science Lab.
Allan L. Lazrus, Elizabeth Lorange, and James P. Lodge, Jr.
Environ Sci and Technol, Vol 4, No 1, p 55-58, Jan 1970. 4 p, 7 fig, 1 tab, 14 ref.

Descriptors: *Water pollution sources, *Air pollution, *Metals, *Precipitation (Atmospheric), *Trace elements, Smog, Ions, Gasoline, Fuels, Pollutants, Industrial wastes, Water pollution.
Identifiers: Lead, Leaded gasoline.

The concentration of lead in the atmosphere is correlated with the amount of gasoline consumed in the U.S., and the concentration patterns for lead and four other metals -- zinc, copper, iron, and manganese -- are engendered primarily by human activity. Six months average values collected during 1966-67 from a network of 32 stations reveal that the northwest portion of the U.S. is conspicuously low in contamination; the northeast is relatively high, and the southwest and southeast vary from low to moderate, depending on the metal. (Knapp-USGS)
W70-02444

WATER QUALITY IN INDUSTRIAL AREAS: PROFILE OF A RIVER,
New York Univ., N.Y. Inst. of Environmental Medicine; and Environmental Protection Administration of New York City.
For primary bibliographic entry see Field 05C.
W70-02493

EXTRACELLULAR PRODUCTS OF PHYTOPLANKTON PHOTOSYNTHESIS,
Westfield Coll., London (England). Dept of Botany; and University Coll., London. Dept. of Botany.
G. E. Fogg, Czeslawa Nalewajko, and W. D. Watt.
Proceedings Royal Society (B), Vol 162, p 517-534, 1965. 6 fig, 4 tab, 31 ref.

Descriptors: *Phytoplankton, Photosynthesis, Bicarbonates, Radioactivity, Carbon radioisotopes, Lakes, Organic matter, Sea water, Primary productivity, Light intensity, Trophic level, Sampling temperature, Tracers, Chlorella, Hydrogen ion concentration, Alkalinity, Diatoms, Temperature, Weather, Epilimnion, Algae, Density, Seasonal, Marine plants, Water pollution sources
Identifiers: *Extracellular products, Photic zone, Glycollic acid, Chemotrophy, Particulate matter, Blelham Tarn (England), Chlorella pyrenoidosa, Fixation, Tringford (England), Anabaena cylindrica, North Sea, Firth of Clyde (Scotland), Scotland, England, Lake Windermere (England), Carbon-14.

Following exposure in situ (3-24 hours) of lake or sea water samples, with added radioactive bicarbonate, radiocarbon was found in phytoplankters and in dissolved organic matter. Amounts in the water varied between 7 and 50% of total carbon fixed in photic zone of the water column. This production of labelled extracellular organic matter occurred under various conditions and with diverse phytoplankters. Estimation of primary productivity from fixation of carbon-14 in particulates only are probably erroneously low. Labelled organic substances in water are apparently liberated by intact photosynthesizing cells rather than from cells broken during filtration. Glycollic acid is possibly a principal substance. Over a wide range of light intensities, liberation of extracellular products by a given phytoplankton population was proportional to the carbon fixed in cells, tending to be relatively greater at low light intensities and at light intensities high enough to inhibit photosynthesis, when as much as 95% of total organic radiocarbon might be extracellular. Population density, period of exposure to labelled bicarbonate, and species differences influence such excretion. Extensive extracellular liberation, by phytoplankton, of photosynthetic products has important implications for studies of aquatic trophic relationships. (Jones-Wisconsin)
W70-02504

REPORT ON THE NUTRIENT SOURCES OF LAKE MENDOTA.
Wisconsin Univ., Madison.

Wisconsin Dep of Resource Development, Madison Water Resources Div, Report to the Lake Mendota Problems Committee, Jan 1966. 41 p, 4 fig, 12 tab, 58 ref.

Descriptors: *Lakes, *Fertilization, *Eutrophication, Sewage, Water chemistry, Precipitation (Atmospheric), Cities, Rural areas, Wetlands, Drainage water, Base flow, Nutrients, Nitrogen, Phosphorus, Seepage, Zoning, Diversion, Wisconsin, Water pollution sources.
Identifiers: *Lake Mendota (Wis), *Nutrient sources, Madison (Wis).

Existing information on the amounts and sources of plant nutrients entering Lake Mendota, Wisconsin, was reviewed and estimates of the current amount of plant nutrients entering the lake were made. Previous studies on the lake's ten tributaries indicated that about 7,100 pounds of soluble phosphorus entered the lake in 1946-1947, equivalent to 0.76 pounds/acre or 0.0075 milligrams/liter phosphorus, with about 200,000 pounds of nitrogen, mostly as nitrates. Streams from predominantly agricultural drainage generally showed low phosphorus and high nitrate nitrogen concentrations. Some tributaries were found to have abnormal concentrations due to contributions from manured land, sewage, and canning waste treatment plants. Estimates of current nutrient sources--to be treated with caution--indicated the following annual contribution from various sources: Municipal and industrial wastewater--nitrogen 47,000 lbs (8%), phosphorus 17,000 lbs (36%); urban runoff--nitrogen 30,300 lbs (5%), phosphorus 8,100 lbs (17%); precipitation on lake surface--nitrogen 97,000 lbs (17%), phosphorus 140 to 7,600 lbs (2%); rural runoff--nitrogen 52,000 lbs (9%), phosphorus 20,000 lbs (42%); ground water--nitrogen 250,000 lbs (45%), phosphorus 600 lbs (2%); nitrogen fixation--80,000 lbs (14%). A total of 556,300 lbs of nitrogen and 47,000 lbs phosphorus were estimated to be entering the lake, although no reliable estimates could be placed on marsh drainage. (Kuncy-Wisconsin)
W70-02506

INDUSTRIAL WASTES.
For primary bibliographic entry see Field 06E.
W70-02548

THERMAL DISCHARGES FROM LARGE NUCLEAR PLANT,
Philadelphia Electric Co., Pa. Dept. of Engineering and Research; and Cornell Univ., Ithaca, N.Y. Dept of Zoology.
Stanley Moyer, and Edward C Raney.
ASCE Proceedings, Journal of the Sanitary Engineering Division, Vol 95, No SA6, Paper 6983, p 1131-1163, Dec 1969. 33 p, 13 fig, 11 tab, 20 ref

Descriptors: *Nuclear powerplants, *Cooling water, *Thermal pollution, *Mixing, *Water pollution control, Canals, Discharge (Water), Jets, Turbulence, Dispersion
Identifiers: *Thermal effluent mixing.

The cooling water requirements of the atomic powerplant on the Susquehanna River are 3350 cfs. Periods of low river flow, high natural river water temperatures, and high wet bulb temperatures are considered the most critical times for aquatic organisms. Hydraulic model tests resulted in the development of an efficient jet injection system which gives maximum mixing. A jet 5 fps to 8 fps at the end of a long canal introduces the effluent throughout the entire depth of the water column in the reservoir. This was superior to the use of a short discharge canal with a weir to release the warm water at the surface. At the critical seasons an increase of ambient water temperature of 13 deg F introduced as a jet was satisfactory in meeting the temperature requirements of the fishes and associated organisms. An open circulating system is to be used with cooling towers to reduce the effluent from 21 deg F to 13 deg F above ambient. Low approach velocities at the cooling water screen structures are recommended to safeguard fishes. (Knapp-USGS)
W70-02635

BRINE SPRINGS IN THE ZWICKAU-OELSNITZ COAL AREA (GERMAN),
Dieter Schraber.
English and Russian summaries. Zeitschrift fur Angewandte Geologie, Vol 14, No 8, p 431-439, Aug 1968. 9 p, 9 fig, 2 tab, 19 ref.

Descriptors: *Groundwater, *Brines, *Springs, *Coal mines, Water chemistry, Salinity, Discharge (Water), Sodium, Potassium, Calcium, Iron, Magnesium, Sulfates, Carbonates, Trace elements, Strontium radioisotopes.
Identifiers: *Germany, Zwickau-Oelsnitz.

A detailed description is presented of the brines emerging from the pits of the Zwickau-Oelsnitz area on the basis of hydrogeological and geochemical studies. Migration of the brines from the source area in the Thuringian basin is the most probable explanation because of the extensive NW-SE fault zones which create the paths followed by the brines. (Gabriel-USGS)
W70-02673

STOCHASTIC BASIS FOR COMPREHENSIVE RIVER BASIN PLANNING: PHASE I,
Union Coll., Schenectady, N.Y. Water Resources Research Group.
For primary bibliographic entry see Field 06A.
W70-02681

CONSIDERATIONS ON HYDRAULIC MODELS TO BE EMPLOYED TO STUDY RECIRCULATION INTAKE CONDITIONS OF COOLING WATER IN STEAM POWER STATIONS,
Universidad de la Republica, Monevideo (Uruguay). Dept. of Fluid Mechanics.
O. J. Maggiolo, and J. Spitalnik.
Journal of Hydraulic Research, Vol 5, No 3, p 189-207, 1967. 3 tab, 5 fig, 10 ref.

Descriptors: *Temperature, *Hydraulic similitude, *Hydraulic models, *Cooling, Path of pollutants, Heat budget, Energy budget, Thermal power plants, Recirculated water, Solar radiation, Heat transfer, Streams, Rivers, Estuaries.

This paper describes the use of models for studying the time necessary for hot water to circulate from the outlet of the condenser to the intake of the cooling water circuit of a thermal power station and temperature time changes of cooling water in the neighborhood of the pump-intake. This can be used in studying of peak load thermal power stations. In this paper the conditions to be fulfilled in the construction of a hydraulic model and the effect of the solar energy radiation are analyzed. The heat transferred to the water from the outside space is neither a function of the water temperature nor a function of the atmosphere temperature. This temperature changes from hour to hour, producing an accumulative effect of heat in the water, characteristic of a non-steady process. The temperature and relative humidity of the air change along the day and the power produced by the station is also variable. These conditions are considered in order to select the most convenient values for the scales of the model. The method is applied to the determination of a model with a horizontal scale of 1:250 and a vertical scale of 1:40 for two steam power stations existing in the Bay of Montevideo on the Rio de la Plata. (Novotny-Vanderbilt)
W70-02707

USE OF RIVER MODELS IN COOLING CIRCULATING WATER STUDIES,
Worcester Polytechnic Inst., Mass. Alden Hydraulic Lab.
L. J. Hooper, and C. N. Lawrence
Boston Society of Civil Engineers, Presented at Meeting held Feb 5, 1958, Hydraulics Section, p 356-365, 1958. 2 fig.

Descriptors: *Hydraulic models, *Cooling, Hydraulic similitude, Heat budget, Temperature, Reynolds number, Froude number, Streams, Heat balance, *Heat transfer, Convection, *Thermal pollution.

The use of hydraulic models for thermal pollution studies is discussed. Such models should satisfy Reynolds' and Froude modified densimetric criteria. Other criteria must be taken into account such as temperature and heat characteristics that sometimes require model construction on a 1/1 (prototype to model) basis. Experimental results show that the most important method of heat disposal has been the heat carried downstream by the river itself. The heat that can be transferred to the air has normally been found to be only a modest amount. Another possibility that should always be examined in a model study and the subsequence analysis of prototype performance is the possibility of heat storage in the pool. (Novotny-Vanderbilt)
W70-02709

COOLING WATER STUDIES AT ELECTRIC POWER STATION,
Duke Power Co., Charlotte, N.C.
Fred R. Gray, and Ben J. Stephenson
Journal of the Power Division, Proceed of ASCE, Vol 95, No PO2, Proc Paper 6853, p 293-303, Oct 1969. 1 tab, 12 fig.

Descriptors: *Hypolimnion, *Thermal power plants, *On site tests, *Thermal pollution, Lakes, North Carolina.

This study correlates field surveys and theoretical analyses of thermal discharges (heat dissipation patterns of power plant cooling water discharges). Duke Power's Marshall steam station was selected as one of the eleven sites for this study. The Marshall steam station is located on Lake Norman, which has a surface area of 32,500 acres and a volume of over 1,000,000 acre-ft. Weather conditions are relatively mild for this area. In order to accomplish the necessary testing, a series of synoptic and continuous temperature monitoring stations were established to measure the diffusion of Marshall steam stations condenser cooling water. A complete weather station records wind speed and direction; solar radiation; relative humidity, rainfall; and maximum and minimum weekly temperatures. Water is drawn from the hypolimnion of an adjoining lake by use of an inverted skimmer. Heat dissipation patterns are displayed for various times of the year and under different meteorological and plant loading conditions by graphic illustrations. Conclusions were: (a) during the colder months of the year, the heated water spreads over the lake surface, where it is quickly cooled by the air and wind, (b) in the hot summer months, use of the cold bottom water for cooling results in discharge temperatures close to those of the lake surface water, (c) extensive temperature surveys have shown that only a small part of Lake Norman's cooling capacity is required to dissipate the waste heat from the Marshall Steam Station. (Guerrero-Vanderbilt)
W70-02713

A HYDRAULIC MODEL STUDY OF HEAT DISSIPATION AT KINCARDINE POWER STATION,
Williamson (James) and Partners, Glasgow (Scotland).
David Ian Hunter Barr
Proc Instn Civil Engineers, Vol 10, p 305-320, July 1958. 9 fig, 27 ref

Descriptors: *Thermal pollution, *Model studies, *Hydraulic models, *Thermal power plants, *Density currents, Stratification.
Identifiers: *Heat dissipation.

A model investigation was conducted to study the heat-dissipating capacity of the River Forth at Kincardine, where a 760-MW steam station would draw 1,025 cusecs of condenser circulating water from the river. After mention of the calculations to ascertain the tidal flow at Kincardine, the operation of the model is described, including reference to observations made on the river to assist calibration of the model and to a concurrently operated model used to investigate outfall scour. The results obtained from the model are outlined and comparison made between recordings for varying conditions. An estimate of heat losses for model and prototype is given, and it is shown that non-correspondence in this respect did not have a material effect on the results in the case of the Kincardine investigation. In the second part of the paper, the background to density-current simulation in models is discussed and flume experiments carried out in this connection are described. Some conclusions were: (a) as a result of the investigation, a considerable reduction in culvert length was made for the Kincardine project; (b) the model showed stratification in depths of less than 1 inch (4 ft prototype) and the degree of stratification was found sensitive to variation in basic density and to the outfall increments; (c) the technique for density current model studies is less fully developed than for models involving normal currents only, and there is scope for research on the subject. (Guerrero-Vanderbilt)
W70-02717

AN EVALUATION OF THE USE OF SELECTIVE DISCHARGES FROM LAKE ROOSEVELT TO COOL THE COLUMBIA RIVER,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
R. T. Jaske.
AEC Research and Development Report, BNWL-208, Feb 1966. 87 p, 24 fig, 7 tab, 17 ref.

Descriptors: *Cooling, *Heat transfer, Mathematical models, Computer models, Reservoirs, Streams, Density currents, Heat balance, Energy budget, Temperature, Thermal pollution, Thermal powerplants.

A review is conducted of the results and general operation of the annual Columbia River cooling program for 1963, 64, and 65. An effort was initiated to develop a digital computer model to solve cooling problems in rivers. In research operations with this model, an appropriate degree of agreement has been obtained between model calculations and measured data. It was found that the existence of density currents and subsurface jet formation cannot be ignored in the development of heat budgets because large errors are introduced by the transition from mixed flow to almost adiabatic flow conditions. A high degree of integration among the flood control, power, and cooling water users interests is required to minimize effects on fisheries. (Novotny-Vanderbilt)
W70-02739

STUDIES ON PHOSPHOROUS TRANSFORMATIONS IN EUTROPHIC LAKES,
Connecticut Univ., Storrs.
For primary bibliographic entry see Field 05C.
W70-02747

INTERACTION OF INORGANIC AND ORGANIC FERTILIZER MATERIALS WITH PESTICIDES AS RELATED TO WATER QUALITY IN SOILS,
Arkansas Univ, Fayetteville. Dept. of Agronomy.
Donald A. Brown.
Available from the Clearinghouse as PB-188 913, $3.00 in paper copy, $0.65 in microfiche. Project completion report, Arkansas Water Resources Research Center, Sept 1969. 9 p, 2 tab, 2 ref. OWRR Project A-004-ARK.

Descriptors: *Diffusion (Self), Adsorption, *Pesticides, Nitrogen, Soils, Herbicides, *Separation techniques.
Identifiers: Time of interaction, Nitrogen sources.

Interaction of Fertilizers with Pesticides - The chemical, physical, and mineralogical analysis of Dundee silt loam, Crowley silt loam, and Sharkey clay were completed. A study of the effect of 6 nitrogen rates for 5 sources of nitrogen upon the adsorption of prometryne, aldrin and fluometuron over four time periods was completed. The effect of (NH4)2SO4, NH4NO3 and Nitrana upon the diffusion of fluometuron in agar, glass beads and Crowley silt loam was also measured. Adsorption of pesticides increased as the time of fertilizer-pesticide interaction was extended. The greatest adsorption of aldrin and prometryne was by Sharkey, followed by Crowley and Dundee. Increasing rates of nitrogen increased or decreased adsorption depending upon changes in pH and salt content. The diffusion of fluometuron in Crowley silt loam was affected by nitrogen sources, rate, and time of interaction. The movement was ten times slower than in glass beads or agar, indicating that a soil-fertilizer-fluometuron interaction was present. The adsorption and diffusion of these pesticides was found to be a very critical function of pH, salt content, and time of interaction.
W70-02761

FERTILIZATION OF LAKES BY AGRICULTURAL AND URBAN DRAINAGE,
Massachusetts Inst. of Tech., Cambridge. Dept. of Sanitary Chemistry.
Clair N. Sawyer.
New England Water Works Association, Vol 61, No 2, p 109-127, June 1947. 5 fig, 6 tab, 6 ref.

Descriptors: *Sewage disposal, *Agricultural watersheds, *Runoff, *Fertilization, Lakes, Sewage treatment, Sewage bacteria, Nitrogen, Phosphorus, Algae, Copper sulfate, Effluents, Microcystis aeruginosa.
Identifiers: *Urban drainage, *Agricultural drainage, Biological response, Fertilization survey, Madison Lakes (Wis), Lake Mendota (Wis), Lake Waubesa (Wis), Lake Kegonsa (Wis).

The reported investigations disclose that agricultural drainage contributes annually about 4,500 pounds of nitrogen and 255 pounds of phosphorus per square mile of the watershed. Biologically treated sewage supplies annually approximately 6.0 of nitrogen and 1.2 pounds of phosphorus per capita, thus equating the enrichment of lake water from 1 square mile of agricultural drainage to 750 persons for nitrogen and to 212 persons for phosphorus. In 1946, lakes Monona, Waubesa, and Kegonsa, located on the outskirts of the city of Madison, received approximately 1,300 tons of nitrogen and 215 tons of phosphorus in organic and inorganic forms. The lakes retained from 30 to 60% of nitrogen received. The phorphorus concentration in lakes Waubesa and Kegonsa attained the high level above 0.25 parts per million (ppm) as compared with 0.01-0.02 ppm concentration found in less polluted lakes of southern Wisconsin. Importance of the hypolimnion, the nitrogen:phosphorus ratio, and a 'round-the-calendar' records is stressed. Microcystis aeruginosa was a particularly obnoxious by-product of eutrophication, either because of its inherent reproductive potential or resistance to copper sulfate. Other data of this report have considerable immediate as well as historical interest. (Wilde-Wisconsin)
W70-02787

CONTRIBUTIONS TO THE KNOWLEDGE OF NITROGENOUS COMPOUNDS AND PHOSPHATE IN THE LAKE WATERS OF JAPAN,
Tokyo Imperial Univ. (Japan). Geographical Inst.
For primary bibliographic entry see Field 05C.
W70-02788

EFFECTS OF ACID MINE WASTES ON PHYTOPLANKTON IN NORTHERN ONTARIO LAKES,
Ontario Water Resources Commission, Toronto. Div. of Research.
For primary bibliographic entry see Field 05C.
W70-02792

HYDROBIOLOGICAL CONTROL OF THE TREATMENT OF WASTE WATERS IN ACCUMULATION PONDS (CZECH),
Technical Univ. of Prague (Czechoslovakia).
V. Sladecek.
Voda, Vol 37, No 4, p 125-126, 1958. 1 fig, 7 ref.

Descriptors: *Water treatment, *Fish farming, *Ponds, *Pollution abatement, Fermentation, Pollutants.
Identifiers: *Polluted discharge, *Burned lime, Hyperputrifaction, Polyputrifaction, Alpha-mesoputrifaction, Beta-mesoputrifaction, Polluted discharge, Accumulation ponds, Sugar beets.

A method is described for purification of liquid discharged from sugar beet factories introduced by Pytlik (1952). The technique consists of anaerobic fermentation of liquid stimulated by two additions to accumulation ponds of finely ground burned lime at a rate of 7500 kilograms/hectare; the first application is made in the fall and the second in winter. In the spring the pond is planted with fish. Aside from purification of the polluted liquid, the method provides from 300 to 500 kilograms/hectare of fish per year. The process of purification, according to the author, exhibits the following four phases: (1) Hyperputrifaction, during 4-1/2 winter months (fifth class of pollution, anaerobiosis); (2) Polyputrifaction, during 1 1/2 spring months (fifth class of pollution, transition to aerobic conditions); (3) Alpha-mesoputrifaction, during one spring month (fourth class of pollution, aerobic conditions); (4) Beta-mesoputrifaction, during 4-1/2 summer months (third class of pollution, aerobic conditions). The study of hydrobiological control failed to provide reliable results due to dilution of discharged liquid by surface runoff. (Wilde-Wisconsin)
W70-02793

5C. Effects of Pollution

WATER QUALITY IN INDUSTRIAL AREAS: PROFILE OF A RIVER,
New York Univ., N.Y. Inst. of Environmental Medicine; and Environmental Protection Administration of New York City.
Gwyneth P. Howells, Theodore J. Kniepe, and Merril Eisenbud.
Environ Sci and Technol, Vol 4, No 1, p 26-35, Jan 1970. 10 p, 5 fig, 2 photo, 1 tab, 6 ref.

Descriptors: Eutrophication, Estuaries, Hudson River, Streamflow, Tidal effects, Nutrients, Water pollution, Thermal pollution, Water utilization, Currents (Water), Saline water intrusion, Estuarine environment.
Identifiers: Hudson River Estuary.

The ecology and water quality of the lower Hudson River were studied to learn the effects of variable fresh water flow, tides, and industrial development on the distribution of inorganic pollutants, nutrients, pesticides, and heat in the estuary. Changes that might be expected from increased use are: An increasing nutrient load from domestic sewage and some industrial processes, an increasing heat load, and an increased demand for industrial and domestic water. Potential eutrophic nuisance species of algae are present in the river, and the shores are populated by animals indicative of sewage pollution. Yet, serious fouling and deoxygenation have so far been avoided for most of the river. Heat additions to the aquatic environment are a major concern. In the Hudson, the volume of tidal flow can be utilized to disperse such heat, at the same time, it is clear that the capacity of the

river as a heat sink is severely limited during the peak summer demand by a low net flow and high ambient air temperatures. The effects of water extraction for any purpose on the present hydrological pattern in the river remain largely unknown. It seems probable that the extent and duration of salt water intrusion up the river will increase. (Knapp-USGS)
W70-02493

THE MECHANISM OF PHOTOSYNTHESIS,
Harvard Univ., Cambridge, Mass. Biological Labs.
For primary bibliographic entry see Field 02K.
W70-02503

EFFECT OF YELLOW ORGANIC ACIDS ON IRON AND OTHER METALS IN WATER,
Minnesota Univ., Minneapolis. Limnological Research Center.
For primary bibliographic entry see Field 02K.
W70-02505

ENUMERATION OF AUTOTROPHIC AMMONIUM-OXIDIZING BACTERIA IN MARINE WATERS BY A DIRECT METHOD,
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 07B
W70-02507

FRESHWATER PRIMARY PRODUCTION BY A BLUE-GREEN ALGA OF BACTERIAL SIZE,
Nature Conservancy, Edinburgh (Scotland); Freshwater Biological Association, Ambleside, (England).
For primary bibliographic entry see Field 02H.
W70-02508

MODERN HYDROCARBONS IN TWO WISCONSIN LAKES,
Princeton Univ., N.J. Dept. of Geology; and Shell Oil Co., Houston, Tex. Technical Services Div.
For primary bibliographic entry see Field 02H.
W70-02509

INTERRELATIONS OF DISSOLVED ORGANIC MATTER AND PHYTOPLANKTON,
Michigan Univ., Ann Arbor. Dept of Zoology.
George W. Saunders.
The Botanical Review, Vol 23, No 6, p 389-409, 1957. 4 tab, 131 ref.

Descriptors: *Organic matter, *Phytoplankton, Limnology, Zooplankton, Algae, Colloids, Trace elements, Dissolved solids, Nutrients, Vitamins, Toxins, Inhibitors, Succession, Chlorella, Chelation, Ochromonas, Bacteria, Fungi, Aquatic plants, Assay, Distribution, Density, Chromatography, Radioactivity, Tracers, Water pollution effects, Physiological ecology, Algicides.
Identifiers: *Dissolved organic matter, Organic debris, Organic growth factors, Vitamin B1, Vitamin B6, Vitamin B12, Biotin, Histidine, Uracil, Reduced sulfur compounds, Antibiotic effects, Stimulants, Gonyaulax catenella, Gonyaulax tamerensis, Gymnodinium brevis, Mycrosystis, Algastatic substances, Algadynamic substances, Phormidine, Pandorinine, Scenedesmine, Microcrustaceans, Cytotoxic agents, Auxotrophy, Autotrophy, Heteretrophy, Nutrition, Physiology.

Limnologists attempt to explain distribution and interrelationships of freshwater organisms from the more conventional physical and chemical points of view. The biochemist and physiologist are beginning to understand basic metabolic pathways of synthesis and degradation. Micro-quantities of both organic and inorganic matter are significant to growth, behavior, and success of living organisms. With the new information from biochemistry and new tools and techniques, such as paper chromatography, chelate complexes, radioactive tracers, and microbiological assay, limnologists may complete the unified picture. The attack may be initiated by use of pure cultures in the laboratory to determine the basic requirements of the more significant algal forms in terms of their ability to utilize various organic substrates, requirement for growth factors, reaction toward antibiotics, and their requirement for trace metals. Limnologists in the field may determine yearly cycles of specific organic nutrients, vitamins, and trace metals. Many questions may be answered by correlating laboratory and field studies with analyses of populations and their succession in nature. These tools should be considered and used to usher in a new era in limnology and the investigation of interrelations of dissolved organic matter, phytoplankton, and zooplankton. (Jones-Wisconsin)
W70-02510

A LIMNOLOGICAL COMPARISON OF TWELVE LARGE LAKES IN NORTHERN SASKATCHEWAN,
Saskatchewan Univ., Saskatoon. Dept. of Biology.
For primary bibliographic entry see Field 02H.
W70-02511

THERMAL DISCHARGES FROM LARGE NUCLEAR PLANT,
Philadelphia Electric Co., Pa. Dept. of Engineering and Research; and Cornell Univ., Ithaca, N.Y. Dept. of Zoology.
For primary bibliographic entry see Field 05B.
W70-02635

NUTRIENT LIMITATION OF SUMMER PHYTOPLANKTON GROWTH IN CAYUGA LAKE,
Cornell Univ., Ithaca, N.Y.
D. H. Hamilton, Jr.
Limnology and Oceanography, Vol 14, No 4, p 579-590, July 1969. 12 p, 3 fig, 9 tab, 32 ref.

Descriptors: *Phytoplankton, *Eutrophication, *Lakes, *Nutrients, Carbon radioisotopes, Silicates, Water chemistry, Phosphates, Photosynthesis, Phosphorus, Sampling, Chlorophyll, Potassium compounds, Magnesium compounds.
Identifiers: Lake Cayuga (NY).

The effect on natural phytoplankton populations of various components of a defined culture medium has been assayed by measurement of C-14 assimilation under controlled conditions. Phytoplankton populations in Cayuga Lake, N.Y. are at least partially limited by nutrient availability during the period of stable conditions succeeding the vernal bloom. Sodium silicate consistently stimulated photosynthesis in June, July, and August; this is associated with the presence of silicon-requiring plankters, including some nondiatomaceous forms, and correlated with nutrient levels in situ. Both phosphate and silicate were present in low concentration. Despite low natural concentration, augmented phosphate did not stimulate photosynthesis, and some evidence suggests inhibition by phosphorus. Inhibition and enhancement by other components of the medium are discussed, as well as modifications of the C-14 enrichment experiment technique (Gabriel-USGS)
W70-02643

LIMITATION OF ALGAL GROWTH IN SOME CENTRAL AFRICAN WATERS,
Malawi Univ., Limbe.
Brian Moss
Limnology and Oceanography, Vol 14, No 4, p 591-601, July 1969. 11 p, 3 fig, 4 tab, 20 ref.

Descriptors: Algae, Productivity, *Eutrophication, *Water chemistry, Pollutants, Algal control, Nitrates, Phosphates, Sulfates, Seasonal, Lakes, Sampling, Ponds, Rivers, Reservoirs, Air temperature, Rain, Geology, Mapping, Nutrients.
Identifiers: Africa, Malawi

Levels of inorganic nutrients (nitrate, phosphate, sulfate) available for algal growth in nine bodies of water in Malawi were investigated, using enrichment bioassays with naturally present algae as test organisms. Nitrate or nitrate plus phosphate were potentially limiting to algal growth. There was no evidence of sulfate limitation. The relevance of enrichment bioassays to whole water body situations is considered. A model, illustrating invalid use of assays in the interpretation of seasonal succession in algal communities, is discussed. (Gabriel-USGS)
W70-02646

INTERACTION OF PESTICIDE POLLUTANTS AND AQUATIC FOOD-CHAIN ORGANISMS,
Clemson, Univ., S.C.
John K. Reed
Available from the Clearinghouse as PB-188 794, $3.00 in paper copy, $0.65 in microfiche. Water Resources Research Institute, Technical Completion Report, Nov 1969. 18 p, 2 tab, 9 ref, append OWRR Project A-013-SC.

Descriptors: *DDT, *Pesticide residues, Fish physiology, Absorption, Pesticide kinetics, Minnows, Gas chromatography, Radiochemical analysis.
Identifiers: *Biological magnification.

Small golden shiner minnows, Notemigonus crysoleucas, were exposed to a constant level of DDT either in water or in food. The DDT was ring labelled with carbon-14 and was assayed in a liquid scintillation system and by gas-liquid chromatography. Over a 15-day period the mean aqueous DDT concentration was 265 parts per trillion which resulted in a level of 180 ppb absorbed to the outside of the fish and 22,530 ppb absorbed internally. This represented nearly a 100,000 fold accumulation of DDT in fish from flowing water. When fish were fed contaminated food, no DDT was found absorbed externally on the fish or in the water. In both cases the level in the fish increased with time.
W70-02677

THE ECOLOGY OF THE YOUNG FISHES OF THE WEWEANTIC RIVER ESTUARY,
Massachusetts Univ., Amherst. Water Resources Research Center.
Charles F. Cole.
Available from the Clearinghouse as PB-188 795, $3.00 in paper copy, $0.65 in microfiche. Massachusetts Water Resources Research Center, Completion Report 69-1, Nov 1969. 15 p. OWRR Projects A-002-MASS

Descriptors: *Estuarine fisheries, *Pesticide residues, *Fish populations, Massachusetts, Water pollution effects.
Identifiers: *Weweantic River, Buzzards Bay, Fisheries (Seasonal distribution), Fisheries (Distribution patterns).

The Weweantic River estuary in upper Buzzards Bay, Massachusetts was selected in 1964 for a long-term study of estuarine fishes and the factors that control their levels of abundance. Seven master's and two doctoral studies have been conducted during this period on the seasonality of fish eggs, larvae, juveniles and adults and on the life histories of the tomcod, rainbow smelt, cunner, tautog, and winter flounder. Additional studies on the seasonal distribution of certain physical and chemical parameters and studies on the historical use of the watershed since colonial times were carried out. Pesticide residue levels and their possible effects in winter flounder have also been investigated. Methods for quantifying ichthyoplankton sampling for in-situ mortality studies of winter flounder and rainbow smelt have also been evaluated. Between-year variation in the natural environmental parameters is a strong factor regulating size of year class in at least the tomcod, rainbow smelt and winter flounder. The study of man caused environmental modifications on populations of estuarine

fishes must take into consideration the scope and nature of these naturally caused variations in population size and structure.
W70-02678

EFFECTS OF CHLORINATED HYDROCARBON INSECTICIDES ON THE FRESHWATER SEED SHRIMP,
South Dakota Univ., Vermillion.
Dr. James C. Schmulbach.
Available from the Clearinghouse as PB-188 796, $3.00 in paper copy, $0.65 in microfiche. Completion Report, Nov 1969. 57 p, 15 tab, 3 fig, 39 ref. OWRR Project A-015-SDAK.

Descriptors: *Insecticides, Bioassay, Crustaceans, Pesticide residues, *Pesticide toxicity, Aldrin, Dieldrin, Bioassay, Lethal limit, Water pollution effects, *Chlorinated hydrocarbon pesticides.
Identifiers: *Ostracods.

The acute toxicities of various mixtures of the two insecticides against laboratory-reared, insecticide-free ostracods were determined. The 24-hour immobility EC50's were 1.15 and 2.45 ppb for aldrin and dieldrin, respectively. Ostracods which were laboratory-reared in the presence of insecticide were also tested to determine if increased resistance or sensitivity to the chemicals had occurred by virtue of chronic exposure. Sublethal exposure to either insecticide through several generations produced populations which were more susceptible to both insecticides. In all instances, ostracods were approximately twice as senitive to aldrin as to dieldrin. Bioassay results using combinations of aldrin and dieldrin demonstrated no synergism or potentiation with respect to the two insecticides. The phenomena of biological accumulation, storage, degradation, and elimination of aldrin and dieldrin were examined. Aldrin was consistently absorbed at a rate approximately twice that of dieldrin. Both insecticides were accumulated against a concentration gradient and stored in the ostracod body. Primary absorption of both insecticides occurred through the gut and body integument; principal storage was in the body per se, with lesser amounts being located in appendages and incorporated in or adsorbed to the shell. Aldrin was rapidly metabolized to dieldrin within the body. No metabolism of dieldrin was observed, but dieldrin was, in part, eliminated from the body when exposed ostracods were placed in insecticide-free water. A complete report of this research is contained in a Degree of Doctor of Philosophy dissertation by Joseph A. Kawatski entitled, 'Toxicity and Methabolism of Two Chlorinated Hydrocarbon Insecticides (Aldrin and Dieldrin) in the Freshwater Ostracod Chlamydotheca arcuata (Sars).'
W70-02679

THE EFFECT OF THE ADDITION OF HEAT FROM A POWERPLANT ON THE THERMAL STRUCTURE AND EVAPORATION OF LAKE COLORADO CITY, TEXAS,
Geological Survey, Washington, D.C. Water Resources Div.
For primary bibliographic entry see Field 02D.
W70-02703

INFLUENCE OF STARVATION ON SELECTED TEMPERATURE OF SOME SALMONIDS,
Carleton Univ., Ottawa (Ontario). Dept. of Biology.
M. Yaqub Javaid, and John M. Anderson.
Journal, Fisheries Research Board of Canada, Vol 24, p 1515-1519, 1967. 1 fig, 16 ref.

Descriptors: Temperature, *Atlantic salmon, *Brook trout, *Rainbow trout, Salmonids.
Identifiers: *Starvation, *Temperature selection.

Starvation was observed to cause changes in the selected temperature of Atlantic salmon, brook trout, and rainbow trout. Fingerlings 2-3 inches in length were acclimated for one month at 20 deg C before 50 fish of each species were isolated. Starvation periods were 22 days, 20 days, and 15 days for salmon, brook trout, and rainbow trout respectively. The fish were tested in groups of 5 or 6 and tests were replicated five times with different fish in each case. In Atlantic salmon an upward shift occurred within 24-28 hours after cessation of feeding. In brook trout and rainbow trout, a downward shift occurred within 24 hours after cessation of feeding. Brook trout showed an initial overshoot. These changes were maintained statistically constant throughout the starvation period, but in all cases the selected temperature returned to its pre-starvation value within 24 hours after resumption of feeding. (Speakman-Vanderbilt)
W70-02706

EFFECTS OF SIMULTANEOUS VARIATION OF TEMPERATURE AND DISSOLVED OXYGEN ON THE RESISTANCE OF FISHES TO CONTROLLED POLLUTANTS,
Connecticut Univ., Storrs.
Walter R. Whitworth.
Research Project Technical Completion Report, Nov 1969. 2 p. OWRR Project A-003-CONN.

Descriptors: *Lead, *Fluctuating temperature, *Brook trout, Fluctuating oxygen, Water pollution effects.

Slug doses of lead administered once a day 5 days/week to brook trout exposed to simultaneous diel fluctuations of dissolved oxygen and temperature showed that concentrations of 25 mg/liter of lead reduced growth. Concentrations of 15 mg/liter had little apparent effect and concentrations of 10 mg/liter had no deleterious effects on growth. Lead levels that were effective had a greater effect (1) when oxygen fluctuated on a diel basis to 2.4 and 3.5, and (2) when temperatures fluctuated from 10.0-16.0. Short-term toxic effects of lead on brook trout, bridled shiners, blacknose dace and banded killifish, at temperatures of 10-21 C, showed (96 hr. EC50) from 4 to 40 mg/liter. Oxygen consumption of bridled shiners was not significantly affected by exposures to 2 and 8 mg/liter of lead. Lead levels of approximated 15 mg/liter had no significant effects on the eggs of brook trout and American shad.
W70-02731

STUDIES ON PHOSPHOROUS TRANSFORMATIONS IN EUTROPHIC LAKES,
Connecticut Univ., Storrs.
Richard C. Tilton.
Connecticut Institute of Water Resources, Research Project Technical Completion Report, Nov 1969. 6 p, 3 ref. OWRR Project A-017-CONN.

Descriptors: *Detergent, *Microbial degradation, *Eutrophication, Lakes.
Identifiers: *Phosphate.

Phosphate has been implicated in the active eutrophication of lakes and ponds. Household and industrial detergents contribute a major portion of phosphate to waste waters. Detergent phosphate enters the water as longchain linear and cyclic phosphate and in such form may not be available for use by algae and green plants without prior bacterial decomposition. Twenty five detergents were analyzed by cellulose thin layer chromatography (TLC) for phosphate compounds and these detergents were subdivided into five major groups depending on the particular phosphates present. Representatives of the major groups were used as sole phosphorous sources for each of eleven species of aquatic bacteria. Phosphorous degradation products were determined by TLC. Data indicated that the ability to decompose detergent phosphates depended upon the species of bacterium tested. Some bacteria utilized pyrophosphate tripolyphosphate, tetrapolyphosphate and trimetaphosphate as phosphorous sources and excreted large amounts of orthophosphate into the medium, while others failed to grow on these complex phosphorous sources. Results suggested that aquatic bacteria play a significant role in the decomposition of detergent phosphate in waste water and to a large extent in the aquatic phosphorous cycle.
W70-02747

CORRELATION OF STRUCTURE VS ACTIVITY OF POLLUTANTS OF FRESH WATER,
Rhode Island Univ., Kingston. Dept. of Pharmacy.
Howard W. Bond, and George C. Fuller.
Technical Completion Report, Rhode Island Water Resources Center, 1969. 16 p. OWRR Project A-021-RI.

Descriptors: *Thiol affinity-sulfhydryl-reactive agents, *Sulfhydryl-thiol affinity-rate assay, *Cysteine-B-nitrostyrene interaction, UV spectrophotometry-reaction monitoring, *Molluscicides.
Identifiers: *Sulfhydryl reactivity, *Oxygen uptake inhibitions, *Cysteine, *B-Nitrostyrenes.

Thirty-one B-nitrostyrenes were tested for their toxicity to the fresh water snail, Australorbis glabratus. All were highly toxic, with B-nitrostyrene itself being the most toxic. Inhibition of oxygen uptake was significantly ($P<0.05$) correlated with sulfhydryl reactivity of the derivatives studied. Homogenate oxygen uptake inhibition was associated with reduced tissue sulfhydryl content. Preincubation of homogenates with cysteine antagonized the effect of B-nitrostyrene on oxygen uptake. Saturation of the B-nitrostyrene nitroolefinic bond resulted in a product (1-phenyl-2-nitroethane) with diminished ability to inhibit oxygen uptake, as well as reduction of sulfhydryl reactivity. These data indicate that the effect of the B-nitrostyrenes on oxygen uptake is mediated through an interaction between the B-nitrostyrene and tissue sulfhydryl material.
W70-02753

ECOLOGY OF SELECTED AQUATIC BACTERIA IN THE SNAKE RIVER,
Washington State Univ., Pullman
Charles H. Drake
Available from the Clearinghouse as PB-188 934, $3.00 in paper copy, $0.65 in microfiche. Completion Report, Washington Water Resources Research Center, Dec 1969. 12 p, 3 tab. OWRR A-018-Wash

Descriptors: Aquatic microbiology, Water quality, *Bioindicators, Pseudomonas, Sulfur bacteria, Water pollution sources, Idaho, Washington

Total counts and counts of selected bacterial genera were made on water samples from the Snake River above and below the Lewiston-Clarkston area. Fluorescent species of Pseudomonas were found to be an important part of the natural aquatic flora with their numbers approximately doubling below the urban area. Counts were made by the Most Probable Number method on a selective medium with positive tubes determined by fluorescence under long-wave ultraviolet light. Numbers of the sulfate reducing anaerobic Desulfovibrio, present in the water from bottom scour, were also determined. Because of the high sulfate content of the water, there was no increase in numbers below the two cities as compared to upstream samples. Total counts on standard plate count agar seemed to mostly detect extraneous non-aquatic species needing high concentrations of organic foods. Counts on the low-nutrient concentration Henrici's agar gave up to 20-fold higher counts. On this medium, Sphaerotilus was detected below but not above the two cities. Indications were that neither phosphate nor fixed nitrogen were limiting factors for the bacterial population. Counts of most species were lowest during the summer when the river water is primarily long-impounded water, from power dams, which has been exhausted of nutrients.
W70-02762

PHYTOPLANKTON FLORA OF NEWFOUND AND WINNISQUAM LAKES, NEW HAMPSHIRE,
New Hampshire Univ., Durham. Dept. of Botany
G. K. Gruendling, and A. C. Mathieson.
Rhodora, Vol 71 (787): p 444-447, 1969. 42 fig, 117 ref. OWRR Project A-010-NH.

Descriptors: *Algae, *Trophic levels, Aquatic environment, Water quality, Nutrients, Northeast U S, Ecological distribution, Biological indicators, New Hampshire.
Identifiers: *Newfound Lake, *Winnisquam Lake, Water and plants, Water pollution effects, Ecology, Water quality characterization.

A total of 185 taxa of fresh water algae (primarily phytoplankton) were identified at Winnisquam (partially eutrophic) and Newfound (Oligotrophic) lakes. Of the 142 taxa recorded at Winnisquam Lake 85 were found exclusively at this location. The green algae contributed the greatest number of species, but the bulk of the standing crop was composed of blue-green algae. A total of 100 taxa were recorded at Newfound Lake, and 43 of these were found exclusively at Newfound Lake. The largest number of species were green algae. During the summer the phytoplankton flora at Winnisquam Lake was primarily composed of members of the Chlorophyceae and Cyanophyceae. Members of the Bacillariophyceae, Chrysophyceae and Chlorophyceae (mainly desmids) contributed the largest number of species during the spring and fall. Diatoms were the major component of the winter flora. The summer and fall flora at Newfound Lake was primarily composed of members of the Cyanophyceae, Chlorophyceae (especially desmids) and Chrysophyceae. The diatoms and golden-brown algae contributed the largest number of species during the winter and spring.
W70-02764

PHYSICAL, CHEMICAL, BACTERIAL, AND PLANKTON DYNAMICS OF LAKE PONTCHARTRAIN, LOUISIANA,
Louisiana Water Resources Research Inst., Baton Rouge.
Daniel H. Stern, and Michele Stern.
Available from the Clearinghouse as PB-188 915, $3.00 in paper copy, $0.65 in microfiche. Technical Report 1R-4, La Water Resources Research Inst, Sept 1969. 60 p, 2 fig, 47 tab, 33 ref. OWRR Project A-019-LA.

Descriptors: *Limnology, *Chemical properties, *Ammonia, *Coliforms, *Phytoplankton, *Zooplankton, *Lake Pontchartrain, Saline lakes, Storm runoff, Physical properties, Nitrification, Nitrites, Nitrates, Dissolved oxygen, Turbidity, Phosphates, Nutrients, Water sports.

Preliminary and intensive studies from November 1968 to July 1969 showed that the discharge of storm water into Lake Pontchartrain, Louisiana affects the water quality and bio-rhythm of aquatic microorganisms. Especially after heavy rains in Orleans Parish, the presence of coliforms renders the nearshore water and beaches unsafe for some water sports. Storm drainage from Jefferson Parish also supplies coliforms that are transported to the New Orleans shoreline. Phosphates, nitrates, and nitrites nourish and bring about increases in phytoplankton and bacteria. Lake sediments, stirred up by wind waves and during heavy rains, increase the turbidity; the reduced light available for photosynthesis results in the death of phytoplankton, which add to the bottom organic materials and subsequently furnish food for more planktonic growth, and thus hastens the filling of the lake. The use of total instead of fecal coliform counts does not give the true degree of pollution because no consistent relationship was found between the two. Recommendations include: counting of fecal coliforms to determine water quality; prohibition or discouragement of swimming, skiing, and other primary water sports at certain beaches after summer rains; careful regulation of proposed chlorination of storm water owing to presence of ammonia, which retards the disinfection process, and because of unreacted chlorine, which will disrupt the natural food chain; and basin-wide cooperation to prevent or reduce further pollution.
W70-02766

ALGAE IN RELATION TO MINE WATER,
West Virginia Univ., Morgantown. Water Research Inst.
H. D Bennett.
PB-188 906. West Virginia Water Research Institute, Journal Report 1, (Reprint from Castanea Vol 34, No 3, p 306-328, Sept 1969). OWRR A-007-WVA.

Descriptors: *Algae, *Acid mine water, *Habitats, *Environmental effects, *Limiting factors, Benthic flora, Benthos, Mine water, Water pollution, Water pollution effects, Acid streams, Mine drainage, Chlorophyta, Chrysophyta, Euglenophyta, Cyanophyta, Diatoms, Aquatic habitat, Population.
Identifiers: *Cytological effects, Algal population.

An annual cycle of bimonthly sampling was done to obtain information on species of algae tolerant to acid mine water and on chemical factors related to ecology of algae. Nitrate, phosphate, and calcium appeared not to be limiting or modifying. Correlation was lacking between factors except acidity, iron, and pH. A range for these characterized each habitat, and they appeared controlling on algal population in more-acid streams. The total number of genera and species compared favorably with numbers reported from 'unpolluted' waters. Nearly half the total species found in more-acid streams equally were in less-acid creeks, rivers, and ponds. Algae characteristic of mine water were those common to the other habitats. Reduction in numbers of species at higher acidity and lower pH was primarily in species less common to a range of habitats. The range of acidity and pH at a site is characterized by a range in species number and abundance a change in abundance being dependent on the species. Some such as Euglena mutabilis Sch., Eunotia tenella (Grun) Cleve, and Pinnularia braunii (Grun) Cleve are most abundant in mine-polluted water. (Dodson-West Virginia)
W70-02770

PHYTOPLANKTON POPULATIONS IN RELATION TO TROPHIC LEVELS OF LAKES IN NEW HAMPSHIRE, U.S.A.
New Hampshire Univ., Durham. Dept. of Botany
G. K. Gruendling, and A. C. Mathieson.
Available from the Clearinghouse as PB-188 912, $3.00 in paper copy, $0.65 in microfiche. Completion Report, University of New Hampshire Water Resources Research Center, Research Report No 1, June 1969. 81 p, 15 fig, 9 tab. OWRR Project A-010-NH.

Descriptors: *Algae, Aquatic environment, *Aquatic algae, Water quality, *Trophic levels, Nutrients, Northeast U.S., Ecological distribution, Frequency distribution, Population, Biological indicators, New Hampshire.
Identifiers: Plant growth, Water and plants, Water pollution effects, Ecology, Effects of pollution, Water quality control, Winnisquam Lake, Newfound Lake.

The relationship between composition, periodicity and abundance of phytoplankton species and the trophic status of two New Hampshire lakes (Winnisquam and Newfound) were investigated. Newfound Lake is oligotrophic, while Winnisquam is undergoing rapid eutrophication. The differences in the total standing crop at the two lakes were related with their differences in nutrient concentrations. Orthophosphate appeared to be the primary limiting factor of algal growth at Newfound Lake, while light, temperature and possible extracellular products were the primary limiting factors at Winnisquam Lake. A discussion of the factors influencing the periodicity, abundance and distribution of phytoplankton species at the two lakes is presented, and the results are compared with previous findings. The species composition at the lakes was dependent upon their trophic status. Dominant species were considered to be the best indicators of trophic levels. A summary of possible rare indicator organisms is also included. The phytoplankton quotients proposed by various authors were applied to the lakes. Most of the indices correctly designated the eutrophic lake, but not the oligotrophic one.
W70-02772

PROCEEDINGS OF THE EUTROPHICATION-BIOSTIMULATION ASSESSMENT WORKSHOP.
California Univ., Berkeley. Sanitary Engineering Research Lab. and Pacific Northwest Water Lab., Corvallis, Oreg.
For primary bibliographic entry see Field 05A.
W70-02775

STRUCTURAL CHARACTERISTICS OF BENTHIC ALGAL COMMUNITIES IN LABORATORY STREAMS,
Oregon State Univ., Corvallis. Dept. of Botany.
C. David McIntire.
Ecology, Vol 49, No 3, p 520-537, 1968. 5 fig, 6 tab, 31 ref.

Descriptors: *Benthic flora, *Algae, *Biological communities, *Laboratories, *Streams, Light intensity, Currents (Water), Velocity, Diatoms, Seasonal, Biomass, Pigments, Productivity, Periphyton, Chlorophyta, Chrysophyta, Cyanophyta, Sampling, Phytoplankton, Organic matter, Chlorophyll, Dynamics, Temperature, Silts, Standing crop, Ecology, Photosynthesis, Respiration, Carbon dioxide, Nutrients, Dissolved oxygen, Lotic environment.
Identifiers: Species diversity, Autecology, Morphology, Export losses, Chemosynthesis, Abundance.

Effects of light intensity and current velocity on species composition and ecological properties of benthic algal communities were investigated in laboratory streams. Of 15 diatom taxa studied, only Melosira varians, Meridion circulare, and Navicula radiosa were more abundant in streams receiving 700-foot-candle illumination than in those receiving 150-foot-candle. Achnanthes exigua, A minutissima, Meridion circulare, Rhoicosphenia curvata, and Navicula radiosa were indifferent to current velocity, which had positive effect on abundance of Nitzschia linearis, Achnanthes lanceolata, Navicula cryptocephala, N minima, N seminulum, Synedra ulna, Gomphonema parvulum, G angustatum, Cocconeis placentula, and the lanceolate Nitzschia. Melosira varians exhibited negative response to current velocity; six taxa, other than diatoms, Anabaena variabilis and Tribonema minor were more abundant in streams with higher light intensity, but only one species, Phormidium retzii, was more abundant in streams with current than in standing water. At a particular season, light intensity, and current velocity--laboratory stream conditions--allow establishment of algal communities with comparatively unique species composition and characteristic biomass, pigment concentration, and increment of export. To understand factors influencing productivity in these communities, some knowledge is necessary of autecologies of community constituents, and mechanisms regulating species composition and floral diversity. (Jones-Wisconsin)
W70-02780

SOME FACTORS AFFECTING RESPIRATION OF PERIPHYTON COMMUNITIES IN LOTIC ENVIRONMENTS,
Oregon State Univ., Corvallis. Dept. of Botany.
C. David McIntire.
Ecology, Vol 47, No 6, p 918-930, 1966. 2 fig, 6 tab, 18 ref.

Descriptors: *Respiration, *Periphyton, *Ecosystems, *Lotic environment, Metabolism,

Velocity, Dissolved oxygen, Temperature, Primary productivity, Biomass, Photosynthesis, Currents (Water), Circulation, Diatom, Chlorophyta, Bacteria, Rotifers, Tension, Diffusion, Oregon, Water pollution effects, Diptera, Midges.
Identifiers: Substrate, Willamette Valley (Oregon), Stigeoclonium, Oedogonium, Tribonema minor, Melosira, Achnanthes, Anabaena, Phormidium retzii, Epithemia, Navicula, Cocconeis, Fragilaria, Closterium, Rhopalodia gibba, Cilliates, Synedra ulna.

Using laboratory streams, a respirometer chamber, and a Gilson differential respirometer, periphyton respiration in lotic environments was studied. Respiration rates expressed on an ash-free dry weight basis, determined for sections of intact communities in air-saturated water, varied between 0.8 milligrams oxygen per gram/hour at 7.2 C and 2.3 milligrams oxygen/gram per hour at 18.6 C for a community grown at current velocity of 38 centrimeters/second, and between 0.4 milligrams at 7.2 C and 1.7 milligrams at 18.5 C for a community grown in current of 9 centimeters/second. These values agreed with rates obtained manometrically in Warburg experiments and values reported in literature. Periphyton developed in swifter current exhibited greater metabolic response to shaking than material grown in slow current. Fast-current communities usually had higher respiratory rate than slow-current. Respiration rates in both decreased when dissolved oxygen concentration was below air saturation, indicating sessile lotic communities were particularly susceptible to oxygen exhaustion in vicinity of respiring cells. Enhancement of respiration with increasing oxygen tension over air saturation was more pronounced at 5 C than at 13 C. Oxygen concentrations over air saturation had greater effect on respiration when flasks were unshaken. (Jones-Wisconsin)
W70-02781

KINETICS OF NUTRIENT-LIMITED GROWTH,
Gulbenkian Inst. of Science, Oeiras (Portugal). Lab. of Microbiology.
N van Uden.
Annual Review of Microbiology, Vol 23, p 473-486, 1969. 60 ref.

Descriptors: *Kinetics, *Nutrients, *Growth rates, Microbiology, Reviews, Diffusion, Yield equations, Metabolism, Yeasts, Water pollution effects, Cycling nutrients, Biomass.
Identifiers: *Microbial growth, *Kinetic theory, *Nutrient limited growth, Michaelis-Menten equations, Monod equation, Saccharomyces cerevisiae, Glucose transport, Candida utilis, Aerobacter aerogenes, Xylitol transport, Escherichia coli, Aerobacter cloacae, Hydrogenomonas, Thiobacillus neapolitanus, Debaryomyces subglobosus, Competitive inhibition, Transport-limited growth, Apparent diffusion, Specific maintenance rates, Energy metabolism, Microbial populations, Nutrient concentrations, Chemostats, Continuous culture, Balanced growth, Diffusion coefficients, Specific death rates, Heterotrophy.

Specific growth rate response of an exponentially growing microbial population to variations in concentration of an essential nutrient, present in non-toxic amounts, indicates that this nutrient limits growth. Microbial growth in chemostats and in open seas are examples of nutrient-limited growth. This publication reviews 60 papers, dated 1942-1969, bearing on the development of kinetic equations to define and describe such growth. 43 equations are presented relating to nutrient-limited growth of microbial populations distributed among the following areas of consideration: fundamental relationship; Michaelis-Menten transfers, including transport-limited growth and competitive inhibition; diffusion transfer, including true and apparent diffusion; and relationship of yield factors (here defined as the sum of biomass and metabolite production) to specific maintenance rate, to parameters of energy metabolism, and to maintenance analysis. Kinetics reviewed are valid for steady-state growth in chemostats, where specific growth rate is often well approximated by the dilution rate of the chemostat. While the equations are useful, none of them constitute a theoretically sound base for development of a kinetic theory of nutrient-limited microbial population growth. While examples are chosen from among the heterotrophic bacteria and yeasts, it appears that equations are equally applicable to algal growth, although not so stated. (Eichhorn-Wisconsin)
W70-02783

CLADOPHORA GLOMERATA AND CONCOMITANT ALGAE IN THE RIVER SKAWA. DISTRIBUTION AND CONDITIONS OF APPEARANCE,
Wyzsza Szkola Rolnicza, Olsztyn-Kortowa (Poland). Katedra Botaniki.
Henryk Chudyba.
Acta Hydrobiologica, Vol 10, No 1-2, p 39-84, 1968. 27 fig, 12 tab, 82 ref.

Descriptors: *Cladophora, Algae, Aquatic algae, Aquatic microbiology, Aquatic productivity, Chlorophyta, Gonophyta, Diatoms, Environmental effects, Limnology, Ecology, Ecological distribution.
Identifiers: *Skawa River (Poland), Montane river course, Carpathian submontane region, Gradients (River), Thalli, Schizomycetes, Cyanophyta, Fungi, Bacillariophyceae, Charophyta, Rhodophyta.

Results of 137 samples collected during September 1-27, 1963 from the River Skawa, Poland, indicated that two groups can be distinguished by thalli: C glomerata rheobenthicum from places with current; C glomerata limnobenthicum from places with no current. The thalli appeared yellow or brown as a result of attached diatoms. The rapidity of current did not play any significant role in formation of the community of accompanying algae. Epiphytes were mainly diatoms, followed by green and blue-green algas. Pennatae diatoms were most common; Navicula and Nitzschia were the most common genus. Groups of algae accompanying C glomerata at all sampling places form one type of community and a single phytocenose with a similar floristic composition and structure. (Fitzgerald-Wisconsin)
W70-02784

CONTRIBUTIONS TO THE KNOWLEDGE OF NITROGENOUS COMPOUNDS AND PHOSPHATE IN THE LAKE WATERS OF JAPAN,
Tokyo Imperial Univ. (Japan). Geographical Inst.
Shinkichi Yoshimura.
Proceedings Imperial Academy of Japan, Vol 8, No 3, p 94-97, 1932. 1 tab, 3 ref.

Descriptors: *Eutrophication, *Nutrients, *Nitrogen, *Phosphorus, Ammonium, Nitrate, Nitrite, Organic nitrogen, Phosphate.
Identifiers: Lake types, Japan.

The amounts of ammonium-nitrogen, (nitrate+nitrite)-nitrogen, albumoid ammonium and soluble phosphate in the waters of 34 Japanese lakes, varying in trophic states, are tabulated. No determination of total nitrogen was made. The general order of each of the constituents measured was: eutrophic greater than mesotrophic greater than oligotrophic. There was little relationship between inorganic nitrogen and soluble phosphate content of the waters. The average nitrogen content (milligrams/liter) was 0.2, 0.2-0.1 and 0.1-0.0 for eutrophic, mesotrophic and oligotrophic lakes, respectively. The corresponding average phosphate contents were 0.1, 0.1-0.05 and 0.05-0.0. The total nitrogen and phosphate contents were constant throughout the year. Shallow lakes were turbid and yellow-colored and high in nitrogen and phosphate while deep lakes were clear and low in nitrogen and phosphate. (Keeney-Wisconsin)
W70-02788

MEASURING ORGANIC MATTER RETAINED BY AQUATIC INVERTEBRATES,
Georgia Univ., Sapelo Island. Marine Inst.
R. E. Johannes, and Masako Satomi.
Journal Fisheries Research Board of Canada, Vol 24, No 11, p 2467-2471, 1967. 1 tab, 14 ref.

Descriptors: *Organic matter, *Invertebrates, *Aquatic animals, Energy, Metabolism, Carbon, Respiration, Rates, Retention, Diatoms, Georgia.
Identifiers: Assimilation, Growth, Ingestion, Release, Palaemonetes pugio, Nitszchia closterium, Sapelo Island (Georgia).

A parameter of energy metabolism by aquatic invertebrates is determine by subtracting the total rate of release of particulate and dissolved organic carbon from input rate of organic carbon in food. This is a measurement of what might be termed retention of organic carbon: the rate at which ingested organic carbon is retained by the animal for growth and respiration. Calculation of this rate requires no knowledge of what fraction of the release products is undigested food and what fraction is derived from assimilated material. Regardless of origin of organic release products, they represent a loss to the animal. This total loss subtracted from food input constitutes the real measure of the organic carbon ingestion rate:total organic carbon release rate is calculated, it can be seen that this value also equals organic carbon assimilation rate:release rate of assimilated organic carbon. Thus, retention will always be less than assimilation. Determination of organic carbon retention by Palaemonetes pugio, feeding on the diatom, Nitszchia closterium, is reported. (Jones-Wisconsin)
W70-02790

PHOSPHORUS EXCRETION AND BODY SIZE IN MARINE ANIMALS: MICROZOOPLANKTON AND NUTRIENT REGENERATION,
Georgia Univ., Sapelo Island. Marine Inst.
R. E. Johannes.
Science, Vol 146, No 3646, p 923-924, Nov 1964. 1 fig, 13 ref.

Descriptors: Phosphorus, Size, Marine animals, *Microorganisms, Zooplankton, Nutrients, Weight, Biomass, Metabolism, Spectrophotometry, Mussels, Amphipoda, Oxygen, Benthic fauna, Invertebrates, Crustaceans, Nannoplankton, Phosphorus radioisotopes.
Identifiers: *Excretion, *Regeneration, Phagotrophic flagellate, Tridacna crocea, Penaeus setiferus, Crassostrea virginica, Modiolus demissus, Uca pugnax, Salpa fusiformis, Littorina irrorata, Lembos intermedius, Artemia salina (Nauplii), Euplotes vannus, Uronema, Calanus finmarchicus, Ciliates, Release processes, Acartia clausi.

Animal excretions are a major source of plant nutrients in the sea. The microzooplankton, not retained by plankton nets, are often overlooked by marine ecologists and their role in nutrient cycles has never been evaluated. Examinations of unfiltered water samples reveal that microzooplankton may often constitute a considerable fraction of the total animal biomass. The smaller the animal the greater the metabolic rate per net weight. Nutrient excretion rate of microzooplankton should, therefore, be higher than that of net zooplankton per unit weight. Excretion rates are defined as the period an animal requires to release an amount of dissolved phosphorus equal to its total phosphorus content, referred to as the 'body-equivalent excretion time.' Research indicated that the ratio of oxygen consumed to phosphorus excreted decreases markedly with decreasing animal size. Lack of parallelism between these two physiological processes deserves investigation. In marine animals the rate of excretion of dissolved phosphorus per unit weight increases as body weight decreases. Consequently microzooplankton may play a major role in planktonic nutrient regeneration. (Jones-Wisconsin)
W70-02791

EFFECTS OF ACID MINE WASTES ON PHYTOPLANKTON IN NORTHERN ONTARIO LAKES,
Ontario Water Resources Commission, Toronto. Div. of Research.
M. G. Johnson, M. F. P. Michalski, and A. E. Christie.
Ontario Water Resources Commission, Division of Research Publication No 30, (1968). 44 p, 6 fig, 5 tab, 15 ref, append A, B, C.

Descriptors: *Algae, *Analytical techniques, *Aquatic algae, Aquatic microbiology, Aquatic microorganisms, Aquatic plants, Aquatic productivity, Balance of nature, Bioassay, Chlorophyta, Cyanophyta, Diatoms, Environmental effects, Essential nutrients, Eutrophication, Bicarbonates, Carbon, Carbonates, Carbon cycle.
Identifiers: *Acid mine water, *Nutrient requirements, *Pollutants, Inhibition, Limnology, Acidity, Acid soils, Acidic water, Acids, Photosynthesis, Photosynthetic oxygen, Physiological ecology, Phytoplankton, Plankton, Pollution abatement, Pollutant identification, Water pollution control, Water pollution effects, Water pollution sources.

Studies were carried out during 1965 through 1967 on three northern Ontario lakes; two (Quirke and Pecors Lakes) were contaminated by quantities of free mineral acidity from uranium milling wastes and one (Dunlop Lake) was unaffected. Differences in chemical composition in the affected lakes, including low pH values and increased concentrations of sulfate ion, nitrate ion, and calcium ion were directly related to processes for the extraction of uranium and subsequent treatment of wastes. Nitrates were in greater supply in the contaminated lakes than in Dunlop Lake, while phosphorus and silica occurred in similar concentrations in all three lakes. Lower phytoplankton populations and indices of diversity were found in Quirke and Pecors Lakes than in Dunlop. Average primary productivities in the three lakes were 126, 71 and 34 milligrams carbon/square meter per day, respectively. In situ areal and volumetric measurements in laboratory and field bioassays confirmed the importance of inorganic carbon in limiting primary productivity. Authors concluded that inorganic carbon limits primary productivity in the lakes contaminated by acid mine wastes. However, they did not separate the effects of reduced pH alone from the effects of reduced inorganic carbon in arriving at that conclusion. (Fitzgerald-Wisconsin)
W70-02792

SOME EFFECTS OF CURRENT VELOCITY ON PERIPHYTON COMMUNITIES IN LABORATORY STREAMS,
Oregon State Univ., Corvallis. Dept. of Botany.
C. David McIntire.
Hydrobiologia, Vol 27, No 3-4, p 559-570, 1966. 4 fig, 11 ref.

Descriptors: *Currents (Water), *Velocity, *Periphyton, *Laboratories, *Streams, *Ecosystems, Biomass, Diatoms, Organic matter, Chlorophyll, Standing crop, Export, Productivity, Protozoa, Cyanophyta, Chlorophyta, Chrysophyta, Aquatic insects, Water pollution effects.
Identifiers: Substrate, Stigeoclonium, Oedogonium, Tribonema, Colonization rate, Achnanthes lanceolata, Navicula, Synedra ulna, Melosira varians, Phormidium tenue, Anabaena, Cocconeis placentula, Rhoicosphenia curvata, Ciliates, Baetis, Chironomus.

Some effects of current at velocities of 9 and 38 centimeters/second, on periphyton communities as determined in laboratory streams, are described. The communities, developing on the substrate, were seeded naturally by organisms entering through the water supply. The colonization proceeded in the following order: small diatoms, large diatoms, cyanophytes, ciliates, and finally chlorophytes, the last only in the slower stream. The diatom community developing in the faster current formed a dense, felt-like growth on the gravel and rubble substrate, and usually appeared dark green or brownish. At the slower current velocity, the community was dominated by species of Stigeoclonium, Oedogonium, and Tribonema, forming long, loose oscillating filaments on the substrate and resembling aggregations of green filamentous algae, often observed in ponds. Although accumulation of biomass on the gravel and rubble was much more rapid in the fast current than slow current, organic matter per unit area of substrate was approximately equal at both velocities at conclusion of the experiment. The export of biomass was consistently greater from the community subjected to the faster current, and at biomasses nearly constant or at steady state, the highest productivity was maintained at the faster velocity. (Jones-Wisconsin)
W70-02794

NUTRIENT-PHYTOPLANKTON RELATIONSHIPS IN EIGHT SOUTHERN ONTARIO LAKES,
Ontario Water Resources Commission, Toronto. Div. of Research.
A. E. Christie.
Ontario Water Resources Commission, Div of Research Publication No 32, Oct 1968. 37 p, 10 fig, 7 tab, 23 ref.

Descriptors: *Algae, *Phytoplankton, *Nutrients, *Phosphorus, *Nitrogen, *Alkalinity, Lakes, Productivity, Phytoplankton.
Identifiers: *Ontario, *Canada, Kushog Lake (Ontario), Twelve Mile Lake (Ontario), Gull Lake (Ontario), Balsam Lake (Ontario), Sturgeon Lake (Ontario), Buckhorn Lake (Ontario), Clear Lake (Ontario), Rice Lake (Ontario).

A chain of eight southern Ontario lakes was sampled from April to September 1967, approximately every two weeks, to depths commensurate with the phototrophic zone. Each lake was sampled at two sites. Analysis of all samples included suspended and dissolved solids; total alkalinity; pH; nitrate, ammonia, organic nitrogen; ortho and acid hydrolizable (standard method's 'Total') phosphorus; algal genera (reported as areal standard units); and chlorophyll a. A few samples were analyzed for calcium, magnesium, iron, sodium, potassium, sulfate, and chlorine. One laboratory growth study on a single sample was reported where glucose, sodium bicarbonate, and a combination of the two was added to flasks containing an 'oligotrophic' lake water sample. Based on this single laboratory experiment and a positive correlation between alkalinity and algal standing crops in the other lake water samples, it was concluded that the upper relatively oligotrophic lakes contained adequate nitrogen and phosphorus, but could support greater algal crops if additional inorganic or biodegradable organic carbon were supplied. In the lower lakes the carbon was concluded to be in ample supply. It was concluded further that entry of nitrogen and phosphorus into all eight lakes should be controlled in the future. (Gerhold-Wisconsin)
W70-02795

THE OBLITERATION OF THE HYPOLIMNION,
Yale Univ., New Haven, Conn. Osborn Zoological Lab.
Edward S. Deevey, Jr.
Memorie Istituto Italiano di Idrobiologia, Suppl 8, p 39-62, 1955. 5 fig, 30 ref.

Descriptors: *Lakes, *Hypolimnion, *Eutrophication, Volume, Stratigraphy, Iron, Oxygen, Phosphorus, Oligotrophy, Sedimentation, Productivity, Diagenesis, Glaciation, Paleolimnology, Lakes, Organic matter, Climatology, History, Bathymetry, Zooplankton, Deciduous forests, Depth, Silica, Ecology, Epilimnion, Carbon radioisotopes, Pollen, Water pollution effects, Hypolimnetic oxygen deficits.
Identifiers: Morphometry, Linsley Pond (Conn), Lake Windermere (England), Biocoenosis, Tanytarsus, Chironomus, Ontogeny, Chaoborus, Cladocera, Bosmina, Allometry, Pine-pollen, Grosser Ploener See (East Holstein), Tippecanoe Lake (Ind), Winona Lake (Ind), Green Lake (Wis).

Eutrophication consists of real increases in biologic productivity, conditioned by increasingly favorable climatic and nutrient conditions in early postglacial time, and halted at equilibrium levels appropriate to climatic and geochemcial ecological requirements. The distinction between true (edaphic) and apparent (morphometric) trophic status is examined, and implications that morphometry of lakes changes automatically as sedimentation proceeds are considered. Ontogeny of Linsley Pond (Connecticut) and of lakes generally, showing characteristics of increasing eutrophication is considered. Quantity of organic matter produced (judging by free quantities in sediments) was sigmoid up to an equipibrium level, as determined geochemically. The process apparently implies eutrophication, although lakes deep and large initially, simply become less oligotrophic, whereas Linsley Pond in reaching its present state of eutrophication, passed through stages characterized by the following midge faunas. Tanytarsus to Chironomus to Chironomus-Chaoborus. This hypothesis would be invalidated of its theoretical significance if it could be shown that eutrophication was an automatic consequence of sedimental filling and in this connection, classification of lakes by chironomid fauna is uncertain. Also compared, on basis of this hypothesis, is the rate of generation of oxygen deficits (per unit area) and then volumetric estimates for Linsley Pond, Lake Windermere, and Grosser Ploener See. (Jones-Wisconsin)
W70-02797

SOME PHYSICAL AND CHEMICAL FACTORS IN THE METABOLISM OF LAKES,
Saskatchewan Univ., Saskatoon.
For primary bibliographic entry see Field 02H.
W70-02798

EUTROPHICATION AND SENESCENCE IN A GROUP OF PRAIRIE-PARKLAND LAKES IN ALBERTA, CANADA,
Joseph Kerekes, and J. R. Nursall
International Association of Theoretical and Applied Limnology, Proceedings, Vol 16, p 65-73, 1966. 4 fig, 4 tab, 9 ref.

Descriptors: *Eutrophication, *Lakes, Hypsometric analysis, Temperature, Depth, Dissolved solids, Alkalinity, Dissolved oxygen, Benthic fauna, Oligochaetes, Plankton, Seston, Weight, Organic matter, Biomass, Surface waters, Productivity, Chemical properties, Nutrients, Volume, Turbidity, Ice, Evaporation, Hydrogen sulfide, Salinity, Water pollution effects, Diptera, Midges.
Identifiers: *Senescence, *Alberta (Canada), Morphometry, Hirudinea, Sphaeriidae, Lake area, Shoreline development, Cooking Lake (Alberta), Ninistik Lake (Alberta), Miquelon Lake (Alberta), Hasting Lake (Alberta), Antler Lake (Alberta), Seasonal effects, Canada.

Five lakes near Edmonton (Alberta), showing advanced eutrophication, are described. In lakes with separate basins, there exists definite correlation between biomass and morphometric factors. This suggests that, other factors being approximately equal, productivity is higher, if total dissolved solids (TDS) is higher, if mean depth is less, or if ratio of shoreline to area is higher. Standing stock of seston during summer in Cooking Lake is perhaps close to the maximum possible in a lake in north temperate zone under natural conditions. Its continuous algal bloom gives appearance of pea soup, and conditions are probably nearly optimal for producing a high standing stock of seston and factors influencing productivity are in 'harmony' in the meaning suggested by Rawson. TDS and alkalinity have ideal concentrations for development of plankton; the lake is large, shallow, and exposed to wind action. Remineralization of plankton is

rapid; nutrients are returned from sediments by mixing. Essential trace elements are probably present. Long daylight hours provide excellent conditions for intensive production. Based on this study, optimal TDS and alkalinity are about 1400 and 450 parts per million, respectively. (Jones-Wisconsin)
W70-02802

OBJECTIONABLE ALGAE WITH REFERENCE TO THE KILLING OF FISH AND OTHER ANIMALS,
Michigan State Univ., East Lansing. Dept. of Botany and Plant Pathology.
G. W. Prescott.
Hydrobiologia, Vol 1, p 1-13, 1948. 6 tab, 14 ref.

Descriptors: *Nuisance algae, *Eutrophication, Cyanophyta, Lakes, Reservoirs, Scum, Nitrogen, Phosphorus, Carbonates, Temperature, Shallow water, Hydrogen sulfide, Copper sulfate, Chlorophyta, Crustaceans, Soil erosion, Sewage effluents, Farm wastes. Population, Industries, Methane, Alkalinity, Hydrogen ion concentration, Toxins, Oxygen, Decomposing organic matter, Water pollution effects, Photosynthesis, Iowa, Chlorine.
Identifiers: Hydroxylamine, Anabaena, Microcystis, Gloeotrichia echinulata, Dinobryon, Synura uvella, Fragilaria, Tabellaria, Melosira, Synedra, Coelosphaerium, Spirogyra, Cladophora, Diaptomus, Cyclops, Gomphonema, Phormidium, Aphanizomenon flos-aquae, Lynghya, Storm Lake (Iowa), Center Lake (Iowa), Diamond Lake (Iowa).

Most troublesome algae in lakes and reservoirs are species of cyanophytes (blue-green algae), which multiply rapidly and tend to float high in the water, forming surface scums. Upon decomposition, malodorous gases and disagreeable tastes are produced. Critical conditions arising from a superabundant growth of algae occur in lakes which are shallow, warm, and rich in nitrogen, phosphorus, and half-bound carbonates. Dense 'blooms' are particularly annoying and often cause economic loss by ruining recreational sites, spoiling drinking water, clogging sand filters, killing fish (directly or indirectly), and killing animals which drink the heavily infested waters. Experiments indicate that fish may be poisoned by products of protein decomposition, including hydroxylamine and hydrogen sulfide, which are released when dense masses of cyanophytes decay. Factors which should be taken into consideration for effective treatment of lakes with copper sulphate are listed. Advantages of applying copper sulphate by spray method are pointed out. A laboratory experiment to test the algicidal action of copper is described. Data indicate that fish can withstand much greater concentrations of copper sulphate than those needed to control algae. (Jones-Wisconsin)
W70-02803

MINERAL NUTRITION OF PHYTOPLANKTON,
Woods Hole Oceanographic Institution, Mass.
Bostwick H. Ketchum.
Annual Review of Plant Physiology, Vol 5, p 55-74, 1954. 2 tab, 126 ref.

Descriptors: *Phytoplankton, *Nutrient requirements, Ecology, Chlorella, Algae, Organic matter, Cultures, Carbon, Metabolism, Nitrogen, Phosphorus, Sulfur, Calcium, Magnesium, Potassium, Sodium, Iron, Manganese, Trace elements, Chelation, Photosynthesis, Carbon dioxide, Bicarbonates, Carbonates, Temperature, Hydrogen ion concentration, Alkalinity, Light intensity, Cyanophyta, Ions, Ammonia, Nitrates, Nitrites, Dinoflagellates, Chlorophyta, Humic acids.
Identifiers: Heterotrophic, Chemotrophic, Autotrophic, Silicon, Pediastrum boryanum, Staurastrum paradoxum, Botryoccus Braunii, Fragilaria crotonensis, Nitzschia, Asterionella gracillima, Growth factors.

Phytoplankton nutrition was studied for understanding ecological conditions for growth. Use of algal organic material as a possible food source has stimulated extensive studies of mass cultures. For comparisons of results, nutrient requirements are defined as: absolute, normal, minimum, and optimum concentrations. Optimum concentration will permit maximum growth rate, reproduction, or photosynthesis of algal populations. This is based upon the concept that an inadequate concentration may result in decreased assimilation rate and an excessive concentration may be inhibitory or toxic. Pure, or at least, unialgal cultures, are needed for this study. Most nutritional investigations have been made on algae species easy to culture which perhaps differ in nutrition and physiology from those difficult to culture. Major absolute requirements include carbon, nitrogen, phosphorus, sulphur, potassium, and magnesium; iron and manganese are required in smaller amounts, sodium is unessential and calcium requirement is contradictory. Silicon is a major requirement for diatom growth but unnecessary for other forms. Various other elements--zinc, boron, cobalt, molybdenum, and copper may be necessary as trace elements. Normal requirements of various algae are given for carbon, nitrogen, phosphorus, under certain conditions. (Jones-Wisconsin)
W70-02804

5D. Waste Treatment Processes

INFLUENCE OF pH ON THE ADSORPTION OF AROMATIC ACIDS ON ACTIVATED CARBON,
North Carolina State Univ., Raleigh. Dept. of Chemistry.
For primary bibliographic entry see Field 05G.
W70-02443

STABILIZATION OF AN ACTIVATED SLUDGE PLANT,
Consoer, Townsend and Associates, Chicago, Ill..
Carl D. Wright.
Water Wastes Engr, Vol 6, No 6, p 34-36, June 1969. 2 fig, 4 tab.

Descriptors: *Activated sludge, *Design data, Efficiency, Biochemical oxygen demand, Costs.
Identifiers: *Plant upset, *Shock loads, Plant modification, Kraus process, Pleasant Hills (Pa), Sludge volume index, Return activated sludge, Waste activated sludge, Clarifiers.

An activated sludge plant (3 mdg) in Pleasant Hills, Pa., operated satisfactorily for several years then became unstable or upset. It was speculated that shock loads caused by shopping centers, motels, and home garbage grinders might be responsible. The plant was converted to the Kraus process with separate aeration of return activated sludge combined with waste digester supernatant and digested sludge solids. The digested sludge solids are converted to an extremely low index activated sludge and the ammonia nitrogen returned in the digester liquor is partially converted to nitrate. This material is introduced to the aeration tanks. The process achieves complete stabilization under shock loads. The plant was modified early in 1968 and has operated satisfactorily since that time. The cost of converting the plant was about $15,000 total. (Ledbetter-Texas)
W70-02593

FACTOR ANALYSIS AS AN AID IN AN ECOLOGICAL STUDY OF ANAEROBIC DIGESTION,
National Inst. for Water Research, Pretoria (South Africa).
D. F. Toerien, W. H. J. Hattingh, J. P. Kotze, P. C. Thiel, and M. L. Siebert.
Water Research (J Int Assn on Wat Poll Res), Vol 3, No 2, p 129-140, Feb 1969. 2 fig, 2 tab, 13 ref.

Descriptors: *Anaerobic digestion, Aerobic bacteria.
Identifiers: *Ecological study, *Factor analysis, Eigen-values, Eigen-vectors, Matrix, Dehydrogenase enzymes, Kinase enzyme, Biotic, Abiotic.

Interrelations between characteristics of an anaerobic ecosystem by means of principal component analysis of the linear correlation coefficient matrix of these characteristics is determined and described. Principal components (factors) were obtained which presented varied characteristics of the ecosystem. The behavior of the factors during a stress period was graphically demonstrated in relation to time. A three-dimensional model yielded visual representation of the behavior of three arbitrary chosen factors in relation to one anoter. It was concluded that factor analysis contributes much towards the determination of the relationships between characteristics and condenses the multitude of test correlations of the ecosystem into interpretable factors. (Ledbetter-Texas)
W70-02594

THE EFFECT OF METHANE ANALOGUES ON METHANOGENESIS IN ANAEROBIC DIGESTION,
National Inst. for Water Research, Pretoria (South Africa).
P. G. Thiel.
Water Research (J Int Assn on Wat Pol Res), Vol 3, No 3, p 215-223, Mar 1969. 4 fig, 15 ref

Descriptors: *Anaerobic digestion, *Inhibition, Hydrogen, Carbon dioxide, Gas chromatograph.
Identifiers: *Toxic substances, *Methanogenesis, Chloroform, Carbon tetrachloride, Methylene chloride, Methane analogues, Warburg flasks, Endogenous methane, Inhibitors.

Extremely low concentrations of chloroform, carbon tetrachloride, and methylene chloride can inhibit methanogenesis in anaerobic digestion. This study was prompted by similar inhibition on rumen microbiota. Along with inhibition of methanogenesis, an accumulation of hydrogen was seen. The inhibition of methanogenesis by 50% from 0.96 mg/l of chloroform, 2.2 mg/l of carbon tetrachloride, or 100 mg/l of methylene chloride may have a bearing on digester operation. The results of this study were compared with those on rumen and the possible role of extracellular hydrogen as an intermediate in anaerobic digestion was discussed. (Ledbetter-Texas)
W70-02595

PHOSPHATE REMOVAL AT FORT WORTH, TEXAS.
Federal Water Pollution Control Administration, Ada, Okla.
J. A. Horn, B. L. DePrater, and J. L. Witherow.
Water Wastes Engr, Vol, No 7, p 40-42, July 1969. 4 fig, 5 tab, 2 ref.

Descriptors: *Activated sludge, *Aeration, Design data, Dissolved oxygen, Municipal waste.
Identifiers: *Phosphate removal, *Operating data, Orthophosphates, Detention times.

The high removal of phosphates by a 30 mgd municipal waste treatment plant using activated sludge process is described. The article presents the design and operating data for the plant. Total phosphate removal for the plant averaged 84 percent. The plant has many similarities to the Rilling Plant in San Antonio, Texas, which reported high phosphate removals; however, there are several significant differences between the two plants. The marked differences are the following: (with Ft. Worth data first then the corresponding Rilling data in parentheses) primary effluent BOD in mg/l- 260 (180); sludge age in days-12 (3.2); SVI in mg/l- 258 (155); BOD loading in lb/day/lb of MLSS+ reaerated suspended solids-0.15 (0.43); BOD loading in lb/day/lb MLSS 0.35 (0.43); and phosphate removal in % - 74 (80). Because both plants obtain high phosphorus removal, the inclusion of reaerated and the differences in sludge age

and BOD loading and concentrations are concluded to be within the limits of design and operation for high phosphate removal. (Ledbetter-Texas)
W70-02596

THE METHANE FERMENTATION BETWEEN MESOPHILIC AND THERMOPHILIC TEMPERATURE RANGES,
California Univ., Davis. Dept. of Civil Engineering.
David J. Hills, and Edward D. Schroeder.
Water Wastes Engr, Vol 6, No 7, p 46-49, July 1969. 5 fig, 1 tab, 13 ref.

Descriptors: *Anaerobic digestion, *Digestion, *Sludge digestion, Model studies, Alkalinity.
Identifiers: *Methane fermentation, *Anaerobic fermentation, Laboratory models, Gas production, Volatile acids, Methane production, Mesophilic bacteria, Optimum temperature.

Raw sludge was screened and rapidly frozen to -30 deg C, then warmed as needed and fed to three 5 gal carboys used as digesters. The digesters had been seeded with mesophilic bacteria. The temperature was raised incrementally from 35 deg to 52 deg C while observing the gas production from methane fermentation. The detention period was 20 days for the digesters. The data obtained show the optimum growth temperature for mesophilic bacteria to be around 41 deg C while 42 deg C marks the upper boundary for growth. (Ledbetter-Texas)
W70-02597

COMPACT ACTIVATED-SLUDGE TREATMENT OF COMBINED PETROCHEMICAL-MUNICIPAL WASTE,
Union Carbide Corp., South Charleston, W. Va.
G. W. Kumke, R. A. Conwan, and J. P. Creagh.
Water Wastes Engr, Vol 6, No 5, p C.1-C.6, May 1969. 7 fig, 2 tab, 5 ref.

Descriptors: *Activated sludge, *Biological treatment, BOD, Industrial wastes, Municipal wastes, Dewatering, Design data.
Identifiers: *Secondary treatment, *Aero-accelator, Thickening, Vacuum filtration, Clarifiers, Comminution, Grit removal, Primary clarification, pH adjustment, Sludge volume index, MLSS, Operating performance, South Charleston (W Va).

A four year evaluation of the activated-sludge treatment of a combined petrochemical-municipal waste in full-scale aerator-clarifier units has been completed. Performance data indicate that the removal capacity of BOD-5 from the mainly petrochemical waste at an 80 percent efficiency reaches 180 lb per day per 1000 cu ft of aeration volume. An average BOD-5 removal of 130 lb per day per 1000 cu ft was obtained. A concentration of 500 mg per L of highly active biological solids could be maintained to accomodate wide variation in wastewater strength and constituents. The effects of detention time, organic loading, and sludge age on performance were delineated. Unit modifications increased the standard oxygen-transfer efficiency to 25 percent, and operating guides were established to push the units to maximum capacity while minimizing shock effects. (Ledbetter-Texas)
W70-02600

WESTERN ELECTRIC BUILDS MODERN PLANT FOR TREATING METAL FINISHING WASTES,
Western Electric Co., Inc., Indianapolis, Ind.
S. F. O'Connor, B. W. Mountjoy, Jr., and N. S. Chamberlin
Water Wastes Engr, Vol 6, No 7, p D.16-D.19, July 1969. 5 fig, 1 tab

Descriptors: *Industrial wastes, *Copper, *Gold, Neutralization, Oxidation, Reduction.
Identifiers: *Metal plating wastes, Cyanates, Hexavalent chromium, Acid-alkali wastes, Segregation of wastes, Tin, Nickel, Silver, Zinc, Sludge dewatering, Operating experience, Oxidation-reduction potential, pH adjustment, Solids removal.

The waste treatment scheme adopted for the metal finishing wastes at the Indianapolis plant of Western Electric is described. The plant variously employs neutralization, oxidation, reduction, solids removal, and solids dewatering. The wastes come mostly from the plating shop and include rinse waters from anodizing, bright-dipping, case-hardening, chromating, cleaning, electroplating, and phosphating. Besides the metals from the plating operations (chromium, copper, gold, nickel, silver, tin, and zinc), the wastes include frequent dumps of spent acid, alkali, and cyanide baths used in the plating operations. Operating results have been excellent with the exception of the segregation of the wastes. This problem will be resolved with time. (Ledbetter-Texas)
W70-02601

THE PROTEOLYTIC BACTERIA PRESENT IN THE ANAEROBIC DIGESTION OF RAW SEWAGE SLUDGE,
National Inst. for Water Research, Pretoria (South Africa).
M. L. Siebert, and D. F. Toerien.
Water Research (J Int Assn on Wat Poll Res), Vol 3, No 4, p 241-250, Apr 1969. 9 tab, 17 ref.

Descriptors: *Anaerobic digestion, Isolates, Protein, Fermentation, Nitrogen-hydrogen, Ureas, Reduction of nitrate, Cellulose, Carbohydrates.
Identifiers: *Raw sludge, *Proteolytic bacteria, Identification, Bacteria typing, Sporeforming, Cocci, Media, Clostridia, Rod-shaped, Bergey's Manual, Liquefaction, Citrate, Albumin.

The occurrence and identity of proteolytic bacteria in the anaerobic digestion of raw sewage sludge were investigated. Proteolytic bacteria occurred in numbers of 65 x 10 to the sixth power/ml. A high proportion of the isolates (65%) was sporeforming bacteria, and included seven Clostridium species. Cocci comprised 21% of the isolates and consisted mainly of Peptococcus anaerobius and one isolate of Staphylococcus aureus. The remaining isolates were non-sporeforming rod-shaped bacteria and included bifid-like bacteria, Bacteroides species and Eubacterium species. (Ledbetter-Texas)
W70-02602

ANAEROBIC DIGESTION: I. THE MICROBIOLOGY OF ANAEROBIC DIGESTION (Review paper),
National Inst. for Water Research, Pretoria (South Africa).
D. F. Toerien, and W. H. J. Hattingh.
Water Research (J Int Assn of Wat Poll Res), Vol 3, No 6, p 385-416, June 1969. 4 fig, 4 tab, 139 ref.

Descriptors: *Anaerobic, *Digestion, *Hydrolysis, Review methane, Carbon dioxide, Microbiology, Metabolism, Respiration, Fermentation.
Identifiers: *Liquefaction, *Gasification, Methanogenic bacteria, Fatty acids, Pathways, Nutrition, Bacterial population.

Anaerobic digestion is defined as a biological process which converts organic matter to methane and carbon dioxide in the absence of oxygen. Anaerobic digestion is considered as a two-step process, acid formation (liquefaction) and gas formation (gasification). Two large, different bacterial populations must be present to reach the end point--the first group converts proteins, carbohydrates, and lipids into fatty acids by hydrolysis and fermentation and the second group converts the fatty acids into methane and carbon dioxide. Article is a review of research done on these two stages of anaerobic degradation with emphasis on bacterial populations and their nutritional and oxygen requirements. The metabolic and catabolic products along with the pathways of formation are delineated as far as is known. (Ledbetter-Texas)
W70-02603

NITROGEN RELATIONSHIPS IN BIOLOGICAL TREATMENT PROCESSES--II. NITRIFICATION IN TRICKLING FILTERS,
Texas Univ., Austin. Environmental Health Engineering Research Lab.
S. Balakrishnan, and W. W. Eckenfelder, Jr.
Water Research (J Int Assn on Wat Poll Res), Vol 3, No 2, p 167-174, Feb 1969. 7 fig, 2 tab, 9 ref.

Descriptors: *Nitrification, *Trickling filter, Ammonia.
Identifiers: *Raschig rings, *Berle saddles, *Specific surface, Hydraulic loading, Acclimation, Organic nitrogen.

A laboratory model trickling filter was used to study the amount of nitrification obtained. The filter had a 6-foot depth of packing with 1-inch Raschig rings and Berl saddles that were hand-packed in the ratio of 2:3. The equation used to represent the percent nitrification was first order with respect to depth but higher order for hydraulic loading. The 2 parameters of fit were derived from the data collected. An increase from 10 MGAD to 30 MGAD caused the percent nitrification to decrease from 72 to 52. A linear relation was found between the rate constant and the specific surface. Temperature is said to have a great influence on the amount of nitrification. (Ledbetter-Texas)
W70-02604

ENGINEERING ASPECTS OF WASTEWATER CONTRACTS,
Gannett, Fleming, Corddry, and Carpenter, Inc., Harrisburg, Pa.
S. I. Zack.
J Sanit Eng Div, Proc Amer Soc Civil Eng, Vol 95, No SA3, Proc Paper 6602, p 465-480, June 1969.

Descriptors: *Contracts, *Financing, *Maintenance, *Management, *Sanitary engineering, Construction, Operation.
Identifiers: Expenses, Consultants, Disputes, Litigation, Ordinances, Sewage service.

The engineering elements essential to the financing, construction, operation and maintenance of sewerage facilities for use by two or more parties are outlined. Among subjects covered are contract terms, conditions, and clauses in successful use which include engineering basis for jointly sharing the capacities of sewage collection and treatment facilities; and for jointly sharing of capital and annual operating and maintenance costs; and also definitions of engineering terms, regulations pertaining to conditions of wastewaters, both domestic and industrial, acceptable from the party being served, as well as how and when payments are made according to actual contracts in effect are given. The importance of scheduling payments to meet commitments are indicated and examples are cited to show how engineering factors and needs of a specific location affect the patterns of a contract. The article emphasizes that no lawyer should endeavor to write a contract without engineering consultation and that no engineer should write a contract without legal advice. (Ledbetter-Texas)
W70-02605

TREATMENT OF KRAFT MILL WASTES WITH A PLASTIC MEDIA TRICKLING FILTER,
Mississippi State Univ., State College; and International Paper Co., Mobile, Ala. Southern Kraft Div.
E. J. Middlebrooks, and Frank J. Coogan.
Water Research (J Int Assn on Wat Pol Res), Vol 3, No 3, p 203-214, Mar 1969. 11 fig, 2 tab, 12 ref.

Descriptors: *Trickling filter.
Identifiers: *Plastic media, *Kraft waste, *Mesophilic-thermophilic, Supplemental nutrients, Diammonium phosphate, Sodium nitrate, Anhydrous ammonia, Clarifier, Preformed filter media, Surfpac, BOD removal, COD removal, Toxic substances, pH, Kills.

A pilot plant trickling filter with preformed plastic media (Dow Chemical's Surfpac) was used to

determine operating conditions for treating a kraft wastewater. Performance was found to be satisfactory at temperatures of 45-50 deg C. The filter plus secondary settling removed more than 60% of BOD applied (neglecting recycle) at 3.7 gpm/ft sq of primary clarifier effluent with 2.0 gpm/ft sq recycle. Overall treatment removed 70% of BOD. Diammonium phosphate and sodium nitrate were used as supplemental nutrients. Sufficient phosphorous in water; therefore, anhydrous ammonia most economical supplement. (Ledbetter-Texas)
W70-02606

NITROGEN RELATIONSHIPS IN BIOLOGICAL TREATMENT PROCESSES--III. DENITRIFICATION IN THE MODIFIED ACTIVATED SLUDGE PROCESS,
Texas Univ., Austin. Environmental Health Engineering Research Lab.
S. Balakrishman, and W. W. Eckenfelder.
Water Research (J Int Assn on Wat Pol Res), Vol 3, No 3, p 177-188, Mar 1969. 13 fig, 3 tab, 15 ref.

Descriptors: *Denitrification, *Nitrogen, *Nitrates, Oxygen, Carbon, Trickling filter, Activated sludge.
Identifiers: Microbial denitrification, TOC, MLSS, Contact-stabilization-denitrification, Batch flow, Continuous flow, Anaerobic, COD.

A laboratory model of modified activated sludge units under both batch and continuous feed conditions was used to study the denitrification of wastewater. The separated sludge is held under anaerobic conditions to require the bacteria to use the oxygen from nitrates and accomplish denitrification. Rate of denitrification increased as the organic matter by TOC increased. Higher denitrification rates accompanied higher nitrate concentrations in the sludge. The presence of oxygen at a level of 6.0 mg/l prevents denitrification. A 4-hr detention at 25 deg C removes 80-90% of the total nitrogen. The process used is 'Contact-Stabilization-Denitrification.' (Ledbetter-Texas)
W70-02607

ANALOG SIMULATION OF ACTIVATED SLUDGE SYSTEMS,
Kentucky Univ., Lexington.
Carl E. Burkhead, and D. J. Wood.
J of Sanit Eng Div, Proc Amer Soc Civil Eng, Vol 95, No SA3, Proc Paper 6631, p 593-606, June 1969. 14 fig, 1 tab, 7 ref.

Descriptors: *Analog computers, *Sanitary engineering, *Sludge treatment, Design, Operation.
Identifiers: *Activated sludge process, Steady state, Transient.

Analog computer solutions of activated sludge design equations are presented for constant, shock, and periodic feed input conditions. From system responses of the aerated lagoon, extended aeration, and separate sludge wasting activated sludge systems to these different inputs, the authors draw the following conclusions: (1) the analog computer can be used to solve nonlinear differential equations for both steady-state and transient solutions; (2) operational changes caused by different plant influents, e.g., shock and periodic loads, and response comparisons of different activated sludge systems to such inputs can be determined using the analog computer; and (3) research is necessary to confirm the ability of present design expressions to describe transient changes in actual plants. (Ledbetter-Texas)
W70-02608

DESIGN PRINCIPLES OF WASTE STABILIZATION PONDS,
Nova Scotia Technical Coll., Halifax.
D. Thirumurthi.
J Sanit Eng Div, Proc Amer Soc Civil Eng, Vol 95, No SA2, Proc Paper 6515, p 311-330, Apr 1969. 8 fig, 6 tab, 22 ref.

Descriptors: *Algae, *Dispersions, *Environmental engineering, *Sanitary engineering, *Sewage treatment, *Tracers, *Water pollution, Design, Design criteria, Oxidation lagoons photosynthesis.
Identifiers: *Model tests, Dyes.

Waste stabilization ponds will be more effectively employed as pollution control systems if suitable design formula and corresponding design parameters are made available to design engineers. To accomplish this objective, an analogy has been drawn between a first-order chemical reactor and a waste stabilization pond. This analogy has resulted in the adaptation of a chemical engineering reactor design equation for designing stabilization ponds. Two design parameters, first-order BOD removal coefficient and dispersion index, were considered as the basis of the new design approach. Synthetic sewage was used to determine the BOD removal kinetics. A control pond, with tap water as the medium and sodium chloride as a tracer, was used to calculate the dispersion index. The interpretation of the results demonstrate the successful applicability of the proposed design formula. An example design problem has been worked out. (Ledbetter-Texas)
W70-02609

PRELIMINARY DESIGN OF WASTEWATER TREATMENT SYSTEMS,
Federal Water Pollution Control Administration, Cincinnati, Ohio.
R. Smith.
J Sanit Eng Div, Proc Amer Soc Civil Eng, Vol 95, No SA1, Proc Paper 6426, p 117-145, Feb 1969. 13 fig, 3 tab, 20 ref.

Descriptors: *Performance, *Sanitary engineering, *Waste treatment, *Water pollution.
Identifiers: 'Expenses, 'Aerators, Incinerators, Sludge drying, Vacuum filters.

A digital computer program is described for preliminary design of a nine process conventional system for treatment of domestic sewage. Volume flow, concentrations of 11 water contaminants present in the feed stream, and decision parameters for each process are supplied to the program as input. Computed output includes volume flow and concentration of each contaminant at all 20 stations within the system, capital and operating cost for each process, and total cost for the system. (Ledbetter-Texas)
W70-02610

KINETICS AND EFFLUENT QUALITY IN EXTENDED AERATION,
California Univ., Berkeley. Sanitary Engineering Research Lab.
E. J. Middlebrooks, D. Jenkins, R. C. Neal, and J. L. Phillips.
Water Research (J Int Assn on Wat Pol Res), Vol 3, No 1, p 39-46, Jan 1969. 5 fig, 1 tab, 23 ref.

Descriptors: *Activated sludge, *Denitrification.
Identifiers: *Extended aeration, *Package plant, 'Comminutor, *Oxigest, Hypochlorinator sludge accumulation, VSS, ML.VSS, COD, Suspended solids, Nitrogen pathways, Polysaccharide substrate removal, Cell yield.

A plant study is reported of an extended aeration package type plant (Oxigest). During the four-month period, the substrate removal rate averaged 0.09 lb COD/lb VSS-day (median 0.06). Influent COD's ranged from 160 to 2300 mg/l and the ML.VSS declined steadily from 5110 to 1810 mg/l. Effluent quality remained about 16 plus or minus 8 mg/l. Suspended matter in the effluent ranged from 8 to 216 mg/l and averaged 25 mg/l (median 42 mg/l). A significant proportion of the soluble effluent COD and the activated sludge solids was a polysaccharide-like material. Nitrogen data indicated denitrification in the secondary settling tank. (Ledbetter-Texas)
W70-02611

EXPERIMENTAL PROBLEMS ASSOCIATED WITH THE TESTING OF SURFACE AERATION EQUIPMENT,
Mixing Equipment Co., Rochester, N.Y.
G. G. Landberg, B. P. Graulich, and W. H. Kipple.
Water Research (J Int Assn on Wat Pol Res), Vol 3, No 6, p 445-455, June 1969. 3 fig, 1 tab, 6 ref.

Descriptors: *Oxygenation, *Aeration, *Reaeration, *Mass transfer, Saturation, Bubbles, Dissolved oxygen.
Identifiers: *Reaeration rate, *Surface aerators, Mass transfer coefficient, Steady state, Reaeration curve, Cobalt ion, Sulfite, Standard saturation, Aerators.

The pitfalls are described in using a first order differential equation to represent the rate of oxygenation (dc/dt) in the determination of the overall mass transfer coefficient K-sub L a. Three regimes prevail in plot of c*-c (log scale) vs time; namely, time of up to 30 min or more for a hydraulic steady state to obtain, during which the slope is too flat; portion where straight line fit approximates the plot very well, where slope is K-sub L a and the steepening part of the plot as c nears c*. Two states of oxygen exist during aeration--finely divided bubbles and truly dissolved oxygen. K-sub L a varies with temperature of water and air, humidity, wind velocity, and sulfate concentration. It is proposed to change base for temperature correction from 1.024 to 1.012. For accuracies of plus or minus 5% in performance, a minimum of 6 tests under varying conditions is required. This accuracy is needed for comparing aerators. (Ledbetter-Texas)
W70-02612

ENERGY CONCEPTS OF AEROBIC MICROBIAL METABOLISM,
Kentucky Univ., Lexington.
Carl E. Burkhead, and Ross E. McKinney.
J Sanit Eng Div, Proc Amer Soc Civil Eng, Vol 95, No SA2, Proc Paper 6505, p 253-268, Apr 1969. 4 fig, 7 tab, 17 ref.

Descriptors: 'Activated sludge, 'Energy, 'Metabolism, Microbiology, Sanitary engineering, Enthalpy, Free energy, Thermodynamics.
Identifiers: 'Aerobic processes, 'Cell yield, Cells (Biology), Substrates

The authors investigated three different energy concepts of cell yield using synthesis data measured in mixed aerobic cultures for 15 different substrates, including, the energy-synthesis concepts of McKinney, Servizi and Bogan, and McCarty. Growth, substrate removal, and oxygen uptake measurements at 25 deg C are correlated with various thermodynamic functions including enthalpy and free energy. Efficiency measurements based upon free energy computations agree with McCarty's results. The study results, however, conflict with the magnitude of cell yield per unit change of free energy of oxidation as estimated by Servizi and Bogan. Conclusions regarding the validity of McKinney's heat loss-cell yield relationship were not possible although the proportionality between heat of reaction and oxygen utilization was verified. This latter relationship is based upon hypothetical oxidative assimilation equations computed from the experimental data and assumed protoplasm formulations. Substrates used in the study included compounds representing the basic food substances of carbohydrates, fatty and amino acids. (Ledbetter-Texas)
W70-02613

THE EFFECTS OF RADIATION ON CHICAGO METROPOLITAN SANITARY DISTRICT MUNICIPAL AND INDUSTRIAL WASTES,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.; and Metropolitan Sanitary District of Greater Chicago, Ill.
C. J. Touhill, E. C. Martin, J. E. Stein, and G. McDonnell.
J Water Pollut Contr Federation, Vol 41, No 2, Part 2, p R44-R60, Feb 1969. 14 fig, 2 tab, 5 ref.

Descriptors: *Radioactivity effects, *Effluent streams, *Municipal wastes, *Industrial wastes, Phenols, E. coli, Spores, Coliforms, Bacteriophage.
Identifiers: *Cyanides, *Total counts, Chicago, Colloids, Dodecane, N-paraffins.

The effects of irradiation on cyanides, phenols, and petroleum-related components, and on the microbial populations of waste effluents, are described. They irradiated the wastes under both batch and continuous flow conditions. Cyanides in concentrations of 0.5 to 45 mg/l (as encountered by the Metropolitan Sanitary District) degraded into innocuous compounds when exposed to 174,000 r in 1 hr. A dose rate of 174,000 r/hr changed phenols to dark brown colloidal suspensions. A 99% conversion of a 1000 mg/l phenol solution required 20 hrs, but the 10 mg/l solution was 95% changed in 30 min. Petroleum-type wastes as simulated by dodecane and normal paraffinic hydrocarbons were rather resistant to radiation change. Organism kill curves showed that 250,000 rads caused the following kills: total counts, 99.995%; coliforms, 100%; enterococci, 100%; spores, 92%; and E. coli phages, 100%. (Ledbetter-Texas)
W70-02614

DOMES PROTECT TRICKLING FILTERS,
Chemung County Sewer District, Elmira, N.Y.
Richard F. Dunbar.
Water and Sewage Works, Vol 116, No 3, p 95-97, Mar 1969. 9 fig.

Descriptors: *Trickling filters, *Plastics, Freezing, Efficiencies, Maintenance.
Identifiers: *Trickling filter covers, *Plastic covers, Styrofoam, Dow Domes, Snow loads, Spiral generator, Wind uplift, Elmira, New York.

The installation of two low-profile plastic (styrofoam) dome covers on 136-ft diameter trickling filters is described. The covers will prevent freezing and will improve the efficiency of the filters. The domes (Dow Domes) were spun on a form adjacent to the filters and lifted onto the filters. Each filter was out of service only 1/2 day. The domes are designed to support snow loads and to prevent wind uplift. (Ledbetter-Texas)
W70-02615

SLUDGE DISPOSAL EXPERIENCES AT NORTH LITTLE ROCK, ARKANSAS,
North Little Rock Sewer Dept., Ark.
Jimmie M. Alford.
J Water Pollut Contr Federation, Vol 41, No 2, Part 1, p 175-183, Feb 1969. 6 fig, 1 tab.

Descriptors: *Sludge disposal, *Centrifugation, *Incineration, Domestic wastes, Dewatering, Operation and maintenance.
Identifiers: *Autogenous combustion, *Centrifuge, *Primary sludge, Fluidized bed, Operating data.

The operating experience of a centrifugal dewatering and autogenous combustion sludge incinerator is described. Primary sludge is stored for 24 to 48 hours to bring solids to 9 to 10% with volatiles of 75 to 80%. Centrifuges (15 mch, 3600 rpm) dewater the sludge to from 32 to 35% solids. A fluidized sand bed incinerator, 9 ft dia, burns the sludge under autogenous combustion at 1100 deg F to 1500 deg F. The unit operates at a pressure of 5 psig and burns 1200 lb/hr of sludge cake with 1500 scfm of air. The air leaving the unit has 240 to 300 lb/hr of fly ash. Power consumption for dewatering and combustion is about 56 kw (75hp) for full load. (Ledbetter-Texas)
W70-02616

A PRIMER ON WASTE WATER TREATMENT.
Federal Water Pollution Control Administration, Washington, D.C. Office of Public Information.

Available from Superintendent of Documents, US Government Printing Office for $0.55 a copy. Federal Water Pollution Control Administration Report CWA-12, Oct 1969. 25 p, 16 photo.

Descriptors: *Waste water treatment, *Sewage treatment, *Water pollution control, *Reviews, Tertiary treatment, Biodegradation, Environmental sanitation, Industrial wastes, Municipal wastes, Domestic wastes, Water pollution sources, Water pollution effects, Sewage effluents.
Identifiers: Federal Water Pollution Control Administration.

Water pollution sources and effects, water pollution prevention, and waste treatment are described in a brief publication intended for use by the general public. The discussion includes methods of collecting and treating wastes, primary and secondary treatment, lagoons and septic tanks, tertiary treatment, pollutants, dilution, disposal, and a glossary. (Knapp-USGS)
W70-02638

THE EFFECT OF ELEVATED TEMPERATURES ON THE TREATMENT OF NORMAL DOMESTIC SEWAGE,
Mississippi State Univ., State College. Dept. of Microbiology.
L. R. Brown, R. G. Tischer, C. M. Ladner, and C. D. Bostwick.
Mississippi State University Report, State College, Mississippi, July 1, 1967. 55 p, 6 tab, 26 fig. OWRR Project A-007-MISS.

Descriptors: *Temperature, *Domestic wastes, *Biochemical oxygen demand, *Chemical oxygen demand, *Biological treatment, Thermophilic bacteria, Waste water treatment, Aerobic treatment, E. coli, Pseudomonas.
Identifiers: Phosphate removal, Suspended solids.

The stabilization of normal domestic sewage at 30 deg C, 45 deg C, 55 deg C, and 65 deg C has been investigated, and it was found that suspended solids removal was essentially the same at all temperatures and averaged between 90 and 94% removal. BOD and COD removal decreased with increasing temperature, and COD removal ranged from as low as 49% at 65 deg to 70% at 30 deg. Settleable solids reduction for the 30 deg C and 65 deg C were 80% and 58%. Thermal death time studies have shown that E. coli and the enterococcus were killed within 30 minutes at 55 deg C and within 10 minutes at 65 deg C. S. paratyphi and shigella sonnei were destroyed within 14 minutes at 55 deg C and within 4 minutes at 65 deg C. There appears to be more organisms in normal domestic sewage which grow at 45 deg C than there are which grow at 55 deg C or at 65 deg C. The major objection to the effluent from the 55 deg C treatment was the turbidity caused by the bacterial population. It has been found that the treatment of the 55 deg C effluent with protozoa markedly decreases not only the turbidity of the effluent but also lowers the COD. (Upadhyaya-Vanderbilt)
W70-02710

DISCHARGE OF SEWAGE EFFLUENT FROM A LINE SOURCE INTO A STRATIFIED OCEAN,
California Inst. of Tech., Pasadena. Dept. of Civil Engineering.
Norman H. Brooks, and Robert C. Y. Koh.
International Association of Hydraulic Research, XI Congress, Leningrad, Sept 1965. 8 p, 3 fig.

Descriptors: *Sewage effluents, *Density stratification, *Oceans, Outlets, Buoyancy, Thermal pollution.
Identifiers: *Plumes.

The case of a two dimensional buoyant plume in a density stratified environment in which the density gradient is uniform is treated. The engineering practice sewage is often discharged into a long line of jets from ports along a straight diffuser pipe; after a brief period of mixing as circular jets, the individual discharges merge into a wide plume as if produced by a virtual two-dimensional source. When the ocean is density stratified, the buoyant plume of sewage may not rise to the ocean surface because the diluted sewage in the plume becomes neutrally buoyant at an intermediate level. The solution presented here presumes vertical upward discharge, and the effects of initial momentum flux and mass flux, as well as buoyancy flux, are considered. An analysis is given, following the method of Morton, for determining the maximum height of rise of a two-dimensional plume as a function of the buoyancy, mass, and momentum fluxes at the source, and the density gradient in the ocean (assumed constant). Mass and momentum flux parameters are found to be of secondary importance compared to the buoyancy flux and density gradient. The theory is briefly illustrated by application to the design of a sewer out-fall for Seattle, Washington. (Guerrero-Vanderbilt)
W70-02714

EFFECT OF BORON ON BIOLOGICAL WASTE TREATMENT,
Delaware Univ., Newark. Dept. of Civil Engineering.
Shankha K. Banerji
Project Completion Report, Sept 1969. 10 p, 3 tab, 1 fig, 3 ref. OWRR Project A-007-DEL.

Descriptors: *Boron, *Toxicity, *Biological treatment, Adsorption, Water quality, Sludge synthesis, Endogeneous respiration.
Identifiers: *Delaware

Water quality of waterways and wastewaters of Delaware were analyzed to determine the extent of boron in the environment. Generally, urban and semi-urban streams had higher boron levels compared to rural ones, indicating that boron may be a good tool to determine man-made pollution. Toxicity of boron in slug doses to aerobic biological waste treatment was determined by using laboratory batch activated sludge units fed with glucose and yeast extract. Using Michaelis-Menten enzyme inhibition model, it was found that the inhibition of boron to activated sludge was uncompetitive. Continuous boron dosing experiments showed that activated sludge cultures did not acclimate to boron after prolonged exposure and the corresponding toxicity of a particular boron dose was higher than that obtained in slug dose conditions. Toxicity of boron on microorganisms were manifested in respiration reactions more so than synthetic ones. Adsorption of boric acid on the clays, illite and kaolinite, and biological sludge was also determined. Significance of this adsorption lies in the fact that further concentration of the sludge after boron adsorption would increase the level of boron several fold, causing problems in subsequent operations, e.g., sludge digestion or land disposal of sludge.
W70-02734

OPTIMIZING SALVAGEABLE WATER RESOURCES IN A SEMI-ARID INLAND BASIN,
Arizona Univ., Tucson.
For primary bibliographic entry see Field 03C.
W70-02745

VIRUS REMOVAL BY CHEMICAL COAGULATION,
Illinois Univ., Urbana. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05F.
W70-02767

5E. Ultimate Disposal of Wastes

DEEP WELL DISPOSAL OF WASTEWATERS IN SALINE AQUIFERS OF SOUTH FLORIDA,
J. I. Garcia-Bengochea, and R. O. Vernon.
Paper presented at 50th Annual Meeting, American Geophysical Union, Wash DC, Apr 21-25, 1969. 15 p, 4 plate, 1 tab, 7 ref.

Descriptors: *Injection wells, *Deep wells, *Waste water disposal, *Florida, Saline water systems, Aquifers, Groundwater movement, Brackish water, Water utilization, Reservoirs, Water storage, Research and development.
Identifiers: Belle Glade, South Florida.

A deep-well disposal system was operated for three years in the highly saline Boulder Zone of the Floridan aquifer in South Florida at Belle Glade. No trace of contamination was detected in an overlying, intermediate saline aquifer. If the hydrogeological conditions found in Belle Glade extend throughout southern peninsular Florida, an ideal situation is available for use of the deeper or Boulder Zone of the Floridan aquifer as a receiving zone of waste disposal. Groundwater flow is to the surrounding seas, discharging at considerable depth and away from shorelines. The less saline water of the upper part of the artesian aquifer can be used as a source of brackish water for future uses, or as an artificially recharged fresh-water storage reservoir. (Carstea-USGS)
W70-02468

5F. Water Treatment and Quality Alteration

POLLUTION OF DRINKING WATER.

Pa Stat Ann tit 18, sec 4640 (1963).

Descriptors: *Pennsylvania, *Potable water, *Water pollution, *Water supply, Water storage, Ponds, Dams, Reservoirs, Legislation, Legal aspects, Water pollution control, Water quality control, Public health, Control, Regulation.
Identifiers: *Penalties (Criminal).

Persons who wilfully enter enclosed land on which is erected any dam, reservoir, pond or other artificial means for storing water used by the public for drinking purposes and pollute or attempt to pollute such water are made subject to criminal penalties. Any duly constituted watchman of any water company or any constable or policeman is empowered, on seeing such a trespass, to arrest the offender and take him before a magistrate for violation of this section. (Keith-Florida)
W70-02522

INDUSTRIAL WASTES.
For primary bibliographic entry see Field 06E.
W70-02548

DOMESTIC WATER SUPPLIES.

Pa Stat Ann tit 35, secs 691.501 thru 691.503 (1964).

Descriptors: *Pennsylvania, *Water quality control, *Water supply, *Water sources, Regulation, Supervisory control (Power), Administrative agencies, Water pollution control, Water quality, Legislation, Legal aspects, State governments, Public health, Water pollution.
Identifiers: Penalties (Civil), Penalties (Criminal), Public nuisance.

The Sanitary Water Board is authorized and empowered to adopt and promulgate orders and regulations for the protection of any source of water that has been approved by the Commissioner of Health or the Department of Health for present or future supply to the public. The Board shall regulate any pollution of such water sources that may be injurious to the public health or objectionable for public water supply purposes. Violations of such orders and regulations are declared to be public nuisances, and are punishable by fine and/or imprisonment. (Sisserson-Florida)
W70-02550

IRON AND MANGANESE REMOVAL FROM SMALL GROUNDWATER SUPPLIES,
Rhode Island Univ., Kingston. Dept. of Mechanical Engineering and Applied Mechanics.
Frank J. DeLuise.
Technical Completion Report, Rhode Island Water Resources Center, 1969. 12 p, 1 tab, 4 fig, 3 ref. OWRR Project A-017-RI.

Descriptors: *Groundwater, *Iron, *Manganese, *Filtration, *Oxidation.

Iron and manganese have been removed from water solution by oxidation and filtration. Oxidation was accomplished by the addition of sodium hypochlorite or potassium permanganate, and filtration was through 0.22 micron membrane filters. The original solutions contained 2 mg/l of iron and 1 mg/l of manganese, and removals to below detection limits (0.025 mg/l iron, 0.0125 mg/l manganese) were accomplished in batch tests. Analysis was by atomic absorption spectrophotometry. Preliminary runs have been made employing this oxidation and filtration system in a flow process using a cartridge filter. Excellent removals of iron and manganese have been obtained, but excessive pressure drops need to be overcome to render the process feasible.
W70-02755

VIRUS REMOVAL BY CHEMICAL COAGULATION,
Illinois Univ., Urbana. Dept. of Civil Engineering.
Richard S. Engelbrecht, and Malay Chaudhuri.
Available from the Clearinghouse as PB-188 911, $3.00 in paper copy, $0.65 in microfiche. Final Report, Illinois Water Resources Center, Research Report No 25, Nov 1969. 66 p, 19 tab, 21 fig, 73 ref. OWRR Project A-020-ILL.

Descriptors: *Coagulation, *Flocculation, *Aluminum, Bacteriophage, Tertiary treatment.
Identifiers: Virus removal, T4, MS2, Coordination complex, Polyelectrolytes.

Using bacterial viruses (Bacteriophages T4 and MS2 against Escherichia coli) as models and aluminum as the coagulant metal ion, it was shown that removal of viruses from water by chemical coagulation and flocculation with aluminum sulfate consists of a primary reaction step which possibly results in the formation of coordination complexes between aluminum and carboxyl groups on the virus coat protein. The complexed viruses were not inactivated and active viruses could be recovered from the settled floc following their removal from water by coagulation and flocculation. The process of chemical coagulation and flocculation was found quite effective in removing bacteriophages T4 and MS 2 from water. The optimum coagulant dosages and pH values were 40 to 50 mg/l of aluminum sulfate at pH 5.24 for bacteriophage T4 and at pH 6.0 for bacteriophage MS2. The highest removals attained were 98.0 and 99.9 percent, respectively. Presence of vivalent cations like calcium and magnesium up to a concentration of 50 mg/l each did not interfere with the efficiency of the process. Organic matter like albumins, wastewater and wastewater effluent lowered the removal efficiency significantly. Commercially available cationic polyelectrolytes were found effective both as coagulant aids and as prime coagulants.
W70-02767

5G. Water Quality Control

INFLUENCE OF pH ON THE ADSORPTION OF AROMATIC ACIDS ON ACTIVATED CARBON,
North Carolina State Univ., Raleigh. Dept. of Chemistry.
Thomas M. Ward, and Forrest W. Getzen.
Environ Sci and Technol, Vol 4, No 1, p 64-67, Jan 1970. 4 p, 3 fig, 2 tab, 14 ref. PHS Grant ES-00177-02.

Descriptors: *Water pollution treatment, *Tertiary treatment, *Activated carbon, *Pesticides, *Chlorinated hydrocarbon pesticides, Aromatic compounds, Hydrogen ion concentration, Adsorption, Thermodynamics, Aqueous solutions, Pesticide kinetics, Water purification.
Identifiers: Aromatic acid removal.

Studies are reported of the adsorption on activated carbon over a wide pH range of 3 herbicides: 2,4-dichlorophenoxyacetic acid (2,4-D); 2-methoxy-3,6-dichlorobenzoic acid (Dicamba); and 3-animo-2,5-dichlorobenzoic-acid (Amiben). Equilibrium adsorption data on these and 7 other structurally related compounds fit Langmuir isotherms in the range of concentrations studied at all pH levels. There is a marked increase in the removal of all solutes from aqueous solutions on lowering the pH below 7.0. Adsorption in the acid region is greater than that expected from the molecular-ionic ratio of the bulk solution. This effect is explained in terms of an enhanced specific ion adsorption resulting from increasing proton concentration as the pH is lowered and a subsequent alteration in the surface properties of the carbon. Maximum adsorption is attained near the point where pH= pKa. At pH 3.0 approximately 50% of the herbicides in 0.0001 molar solution was adsorbed by 0.01 g of activated carbon in 4 hours. At pH 7.0, the removal generally ranged from 8-22%, and at pH 11.0, from 2.5-15%, depending on the specific herbicide present. (Knapp-USGS)
W70-02443

INTERSTATE COMMERCE - NAVIGABLE RIVERS - INDUSTRIAL WASTE CLOGGING CHANNEL HELD NOT UNLAWFUL OBSTRUCTION - UNITED STATES V REPUBLIC STEEL CORP (7th CIR 1959).

Harv L Rev, vol 73, no 6, p 1228-1231, Apr 1960. 4 p, 20 ref.

Descriptors: *Rivers and Harbors Act, *Navigable rivers, *Federal jurisdiction, *Navigation, Obstruction to flow, Legal aspects, Judicial decisions, Legislation, Regulation, Jurisdiction, Permits, Channels, Wastes, Liquid wastes, Solid wastes, Structures, Piers, Docks, Lake Michigan, Federal Government, United States, Rivers, Harbors, Barriers, Reasonable use, Industrial wastes
Identifiers: *Interstate commerce, *Injunction (Prohibitory), Calumet River, Penalties (Criminal).

Three steel companies were enjoined, under authority of the Rivers and Harbors Act of 1899, from depositing industrial wastes in a federally maintained channel. The circuit court in United States v Republic Steel Corp., 264 F2d 289 (7th Cir 1959), reversed on the grounds that obstructions resulting from deposits of solid wastes in suspension are not prohibited and injunctive relief is limited by statute to removal of structures. There are three possible common law bases for governmental relief: the jurisdictional grant in cases in which the United States is a party; the admiralty clause; and the commerce clause. An analysis of judicial decisions in which these jurisdictional bases have been invoked indicates that the government's success or failure in invoking these bases has depended on the type of interest it sought to protect. The courts have given standing to governmental attempts to protect an interest in internal functions but have denied standing where the interest is that of the sovereign representing the rights of its people. (Keith-Florida)
W70-02512

REMARKS BY CONGRESSMAN WILLIAM C. CRAMER BEFORE THE 56TH ANNUAL CONVENTION, NATIONAL RIVERS AND HARBORS CONGRESS.

Proceedings of the 56th Annual Convention, Nat'l Rivers and Harbors Congress, p 58-60, May 13-15, 1969. 3 p.

Descriptors: *Water resources development, *Federal budgets, *Political aspects, *Federal project policy, Project planning, Project purposes, Projects, National income, Water pollution control, Water pollution, Pollution, Water policy, Federal Government, Pollution abatement, Sewage treatment, Cost-benefit ratio, Costs, Cost-benefit theory, Cost-benefit analysis.
Identifiers: *National Rivers and Harbors Congress.

Good leadership in developing and preserving the Nation's water resources is essential to our country's future. Pollution and lack of conservation could become our most critical problem. Our pollution control programs must be upgraded. It is inexcusable that of the funds authorized for sewage treatment plant construction, only 30 percent in 1969 and 20 percent in 1970 were recommended. A new approach is being planned which would set a financing base, and the House Committee on Public Works is scheduling an investigation on the subject of updating the elements of the benefits-to-cost ratio. The Congress and the National Rivers and Harbors Congress should continue to oppose user charges. This year, additional basin authorizations will have to be considered and perhaps a two-year authorizing basis will be put on. When the Ominbus Rivers, Harbors, and Flood Control Bill is considered next year, the much needed water resources projects could possibly be included. (Smith-Florida)
W70-02513

PREVENTION OF POLLUTION.

U Det L J, vol 37, no 1, p 144-149, Oct 1959. 6 p.

Descriptors: *Michigan, *Water pollution control, *Sewage treatment, *Pollution abatement, Cities, Local governments, Regulation, Governments, Water supply, Sewers, Sewerage, Water pollution sources, Diseases, Sewage disposal, Treatment facilities, Disposal, Rivers, Streams, Costs, Financing, Government finance, Riparian rights, Planning, Resource development, Reasonable use, Administrative agencies.

The use of surface and groundwater for drinking or potable purposes is not always compatible with the disposal of domestic and industrial waste to the same source. There is a need for planning and regulation of the use of our water resources. Although the doctrine of riparian rights has prevailed since early times, judicial interpretations have gradually altered the meaning of the doctrine. The riparian doctrine of reasonable use is a modern source of pollution control. Such pollution control in Michigan dates back to the Civil War days. Today, the Water Resources Commission serves to control pollution. The United States Public Health Service has sponsered numerous programs of aid to municipalities under the new Federal Water Pollution Control Act. Many cities have also enacted antipollution ordinances on their own. Existing laws with public support and adequate enforcement staffs should be sufficient and adequate to abate pollution problems. However, there needs to be more inter-governmental cooperation in enforcement. Many raw sewage treatment plants have been completed or planned, but more must be done to arouse public support and to plan for future legislation and financing. (Smith-Florida)
W70-02514

WATER CONSERVATION AND RECLAMATION FUND.
Pa Const art 8, sec 16

Descriptors: *Pennsylvania, *Water conservation, *Water reuse, *Water resources development, Legislation, Legal aspects, Water resources, Pollution abatement, Water pollution, Recreation, Financing, Construction, Sewage, Pollutants, Water quality control, Treatment facilities, Acid mine water, Mine wastes, Mine acids, Waste water (Pollution), Water pollution sources

The State, by its constitution, is authorized to issue bonds in the amount of five hundred million dollars for a Land and Water Conservation and Reclamation Fund. The Fund will be used for the conservation and reclamation of land and water resources, for the elimination of acid mine drainage, sewage and other pollution from the streams of the state, and for providing financial assistance to state political subdivisions for the construction of sewage treatment plants, restoration of abandoned strip-mine areas, and development of park and recreational areas. (Keith-Florida)
W70-02518

POTOMAC RIVER POLLUTION.
Pa Stat Ann tit 32, sec 741 (1967).

Descriptors: *Pennsylvania, *Water pollution control, *Interstate compacts, *Interstate commissions, Interstate rivers, Water resources development, Governments, State governments, Federal government, Water policy, Water pollution, Water pollution sources, Legislation, Legal aspects, Surveys, Waste water (Pollution), Industrial wastes, Data collections, Inter-agency cooperation, Regulation, Standards, Classification, Administrative agencies, Financing.
Identifiers: Potomac River.

A commission is hereby created to act jointly with other member states on the Interstate Commission on the Potomac River Basin. The Governor is authorized to enter a compact with the other members in regard to the abatement of existing pollution and control of future pollution of interstate streams. The states of Maryland, West Virginia, Pennsylvania, and Virginia, and the District of Columbia shall comprise the Potomac Valley Conservancy District. The Commission, composed of representatives from member states, is empowered to: (1) collect and analyze data on pollution; (2) cooperate with local, state and federal agencies in formulating rules and regulations for pollution control and prevention; (3) disseminate public information in relation to stream pollution problems; (4) make, revise, and recommend reasonable minimum standards for treatment of sewage and industrial or other wastes before discharge into the waters of the district; and (5) establish reasonable physical, chemical, and bacteriological standards of water quality satisfactory for various classifications of use. Operations of the Commission shall be financed by the United States and the member states on a pro rata basis. (Kelly-Florida)
W70-02535

POLLUTION OF WATERS.

Pa Stat Ann tit 32, sec 815.31-815.35 (1967), as amended, (Supp 1969).

Descriptors: *Pennsylvania, *Delaware River Basin Commission, Boundaries (Property), Interstate rivers, *Water resources development, Water pollution control, Water policy, Interstate commissions, Administrative agencies, Planning, Legislation, Interstate compacts, Legal aspects, River basin development, River basins, Supervisory control (Powers), Delaware River, Water conservation, Pollution abatement.
Identifiers: *Intergovernmental cooperation.

The part of the Delaware River Basin lying within the boundaries of Pennsylvania is hereby declared to be a component part of an interstate region for the purpose of intergovernmental cooperation in the conservation, protection and development of water resources by means of integrated planning. The Delaware River Basin Commission is recognized as the established regional commission for such intergovernmental cooperation in this area. The Department of Health is directed to apply and carry into effect the provisions of the interstate agreement concerning control and abatement of pollution. The Department is hereby authorized to cooperate with the Commission in regard to pollution control and abatement, and in regard to further study of the sanitary condition of the waters of the Delaware River and its tributaries. (Kelly-Florida)
W70-02538

OHIO RIVER VALLEY WATER SANITATION COMPACT.

Pa Stat Ann tit 32, secs 816.1-816.7 (1967).

Descriptors: *Interstate compacts, *Interstate commissions, *Water pollution, *Pennsylvania, New York, Illinois, Kentucky, Indiana, Ohio, Tennessee, West Virginia, River basin commissions, Ohio River, Legal aspects, Pollution abatement, River basins, State governments, Water policy, Administrative agencies, Interstate rivers, Industrial wastes, Watershed management, Watersheds (Basins), Water quality control.

This Compact was entered into by the states of Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Tennessee, and West Virginia for the purposes of abating existing pollution and controlling any future pollution in the Ohio River Drainage Basin. The Compact establishes a Water Sanitation Commission which is composed of three representatives from each of the signatory states and three from the federal government. The functions of the Commission include the study of the pollution problems of the Ohio River Valley Water Sanitation District, the submission of reports for the prevention or reduction of stream pollution, and the recommendation of appropriate legislation dealing with water pollution problems. The Compact provides a procedure by which the Commission may order any municipality, corporation, person, or other entity discharging sewage or industrial waste into the Ohio River or any other river to discontinue such discharge, and it provides that such order shall be enforced by the courts of the signatory states. (Smith-Florida)
W70-02539

POLLUTION: TRESPASS ON STATE HATCHERIES.
Pa Stat Ann tit 30, secs 200-204 (Supp 1969).

Descriptors: *Pennsylvania, *Fish conservation, *Fish hatcheries, *Water pollution control, Legislation, Legal aspects, Explosives, Poisons, Fish management, Pollution abatement, Water pollution, Permits, Natural resources, Aquatic life, Administrative agencies, Beds, Banks, Obstruction to flow, Pollutants, Civil engineering.
Identifiers: *Trespass, Penalties (Criminal), Penalties (Civil).

No person will place in any waters of the state any electricity, explosives, or poisonous substance for the purpose of catching, injuring, or killing fish. No person will allow any substance harmful to fish to enter the waters of the state in the absence of a showing that every reasonable means has been used to abate and prevent such pollution. Explosives may be used for engineering purposes if a permit for such use has been obtained from the proper national, state, or local authority. Both civil and criminal penalties are provided for violation of the foregoing provisions. It is unlawful to fish or trepass on any waters, beds, or banks of any fish hatchery controlled by the Fish Commission. It is also unlawful to wilfully or maliciously damage any Commission property, or obstruct or pollute the water of any state hatchery. Criminal penalties are provided for the violation of the foregoing provisions. (Keith-Florida)
W70-02543

MISCELLANEOUS PROVISIONS (RELATING TO WATER).

Pa Stat Ann tit 30, secs 351, 361, 381, 391, 392 (1958).

Descriptors: *Pennsylvania, *Water pollution, *Oysters, *Interstate compacts, Legislation, Legal aspects, Canals, Rivers, Lakes, Ponds, Streams, Clams, Fish conservation, Delaware River, New York, New Jersey, Interstate rivers, Regulation, Industrial wastes.
Identifiers: *Set-nets, Penalties (Criminal), Rivulets.

It is unlawful for any person to place a set-net across any of the canals, rivulets or creeks of the state. All persons engaged in manufacturing or hide tanning who wash ore or use vitrol in the tanning process will prepare a tank to filter out wastes to prevent those wastes from entering the waters of the state. The importation into the state of oysters and clams for sale by unlicensed non-residents is prohibited. Violation of state conservation or fish laws in that part of the Delaware River lying between Pennsylvania and New York or Pennsylvania and New Jersey may be prosecuted in the state in which the violation was committed; this section will become effective when either New York or New Jersey enacts a similar law. Criminal penalties are provided for violation of any of the foregoing provisions. (Keith-Florida)
W70-02544

INDUSTRIAL WASTES.
For primary bibliographic entry see Field 06E.
W70-02548

PETTY POLLUTION.

Pa Stat Ann tit 35, secs 691.401 thru 691.403 (1964).

Descriptors: *Pennsylvania, *Water pollution control, *Water pollution, *Regulation, Administrative agencies, Supervisory control (Powers), Permits, Water quality control, Pollutants, Explosives, Legislation, Legal aspects, Public health, Aquatic animals, Industrial water, Recreation.
Identifiers: Penalties (Civil), Penalties (Criminal), Nuisance.

It is unlawful to put or place any explosive or other substance into the waters of Pennsylvania that may be injurious to the public health, animal or aquatic life, or industrial or recreational uses of such waters. Explosives may be used in such waters if a permit for such use has been given by the proper national, state, or local authority. Violations of these provisions are declared to be public nuisances, and are punishable by fine and/or imprisonment. The Sanitary Water Board is empowered to adopt reasonable rules to prevent such pollution. (Sisserson-Florida)
W70-02549

OHIO RIVER VALLEY SANITATION COMPACT.

Ky Rev Stat Ann sec 224.190 (Supp 1968).

Descriptors: *Kentucky, *Water pollution control, *Waste disposal, *Interstate compacts, Planning, Administration, Coordination, Legislation, United States, Local governments, State governments, Interstate commissions, Water pollution sources, Water policy, Water purification, Water pollution, Sewage treatment, Solid wastes, Sewage, Sewage disposal, Industrial wastes, Water pollution effects.

The Ohio River Valley Sanitation Compact, negotiated between Illinois, Indiana, Kentucky, New York, Ohio, Pennsylvania, Tennessee and West Virginia, is accepted by Kentucky. The purpose of the Compact is to reduce and control the pollution of the Ohio River Valley. Each state has pledged full support and cooperation and agrees to establish the Ohio River Valley Sanitation Commission. The Commission shall consist of three members from each state and three members representing the United States Government. The guiding principle of this compact shall be that pollution by sewage or industrial wastes originating within a signatory state shall not be allowed to injuriously affect the various users of interstate waters. All sewage or wastes shall be treated so as to remove all settleable solids and 45% of the suspendable solids. The Commission shall study and recommend pollution programs directed towards the interstate pollution problem. The Commission may issue orders requiring or forbidding conduct which involves pollution, and such orders are enforceable in any court of general jurisdiction or any United States District Court. (Darragh-Florida)
W70-02571

REAERATION MEASUREMENTS IN AN ESTUARY,
Dames and Moore, New York.
David W. Juliano.
ASCE Proceedings, Journal of the Sanitary Engineering Division, Vol 95, No SA6, Paper 6987, p 1165-1178, Dec 1969. 14 p, 7 fig, 5 tab, 12 ref, append.

Descriptors: *Reaeration, *Estuaries, *California, Winds, Waves (Water), Turbulence, Dissolved oxygen, Water quality, Oxygenation.
Identifiers: Sacramento-San Joaquin Delta (Calif).

Measurements of surface reaeration for the Sacramento-San Joaquin Delta were computed from observed diurnal dissolved oxygen changes in the estuary. The reaeration constants varied between 0.16 and 3.91 grams per cu m per hr at 0% saturation. Independent in-situ measurements using gasometeric and disturbed equilibrium methods were conducted for comparison. Reaeration constants varied from 0.64 to 2.84 gm per cu m per hr using the gasometric method. The disturbed equilibrium method yielded reaeration constants between 0.62 and 1.70 gm per cu m per hr. The independent methods showed reaeration constants to be highly variable. Surface turbulence proved to be the most important mechanism controlling reaeration constants in the estuary. Wind velocity was the singularly most significant parameter in causing surface turbulence. (Knapp-USGS)
W70-02636

A PRIMER ON WASTE WATER TREATMENT.
Federal Water Pollution Control Administration, Washington, D.C. Office of Public Information.
For primary bibliographic entry see Field 05D.
W70-02638

CLEANING OUR ENVIRONMENT - THE CHEMICAL BASIS FOR ACTION,
Lloyd M. Cooke.
Report available for sale from American Chemical Society, Special Issues Sales, 1155 Sixteenth St, NW, Wash DC - 20036. Price - $2.75. American Chemical Society Report by Subcommittee on Environmental Improvement, Committee on Chemistry and Public Affairs, 1969. 249 p, 16 fig, 39 tab, 522 ref.

Descriptors: *Environmental engineering, *Pollution control, *Environmental sanitation, *Environmental effects, Air pollution, Water pollution, Water pollution control, Waste disposal, Water treatment, Air pollution effects, Pesticides, Public health, Sanitary engineering, Wastes, Water quality, Water chemistry.
Identifiers: *Environmental management, Pollution control chemistry.

The chemical aspects of air and water quality, and of environmental management in general, are discussed primarily for the involved and educated layman, particularly those involved in legislative and regulatory work. Scientists and engineers not working directly in the field of environmental management may also be interested. An objective account of the current status of the science and technology of environmental improvement is given. The information is analyzed and measures are recommended which should help, if adopted, to improve conditions and accelerate technological development. A bibliography of 188 entries is included. (Knapp-USGS)
W70-02640

DETERMINATION OF SPACINGS OF PARALLEL DRAINAGE SECTIONS AND FILTER-WELL SERIES IN OPENCAST MINE DRAINAGES (GERMAN),
Lothar Richter.
Russian and English summaries. Zeitschrift fur Agnewandte Geologie, Vol 14, No 8, p 420-429, Aug 1968. 10 p, 9 fig, 4 tab, 8 ref.

Descriptors: *Drainage engineering, *Drainage density, *Drainage effects, *Well filters, *Mine drainage, *Mathematical studies, Hydrogeology, Estimating, Groundwater, Water level fluctuations.
Identifiers: *Filter wells, Parallel drainage spacing.

Hydrogeological analytical methods for the practical determination of parallel filter-well bars and drainage-section spacings are reviewed and an empirical method for determining filter spacing is discussed. Hydrological equations of the reviewed methods are critically analyzed. (Gabriel-USGS)
W70-02674

DELAWARE RIVER BASIN COMMISSION ANNUAL REPORT 1969.
Delaware River Basin Commission, Trenton, N J

Delaware River Basin Commission, Trenton, NJ, 08663, 1969. 21 p.

Descriptors: *Water policy, *Interstate, *Institutions, *Water pollution control, Cost sharing, Regulation, Water pollution, Pollution abatement.
Identifiers: Effluent standards, Abatement schedules, Centralized waste treatment systems.

This is the annual report of the only interstate-federal organization covering the full range of water management in the United States. The economic significance of the report relates mostly to water quality control. The commission first adopted river quality standards similar to those imposed elsewhere. It was then estimated that this required a reduction by two-thirds of the oxygen-consuming wastes entering the estuary. This total was then subdivided into four zones, since it was found that economic efficiency would not be served by similar treatment of all zones. During 1969 an allotment was made to each industrial and municipal treatment plant of its maximum contribution to the total load. This transposes the stream standards, which represent only a general objective, to effluent standards, which represent a specific restraint on the individual polluter. Following this, abatement schedules are approved, by which the timing for meeting the target is agreed upon. A number of appeals are still pending, but 74% of the dischargers have already accepted the effluent standards. Progress is also being made towards organizing centralized (or 'regional') waste collection, conveyance and treatment systems, which are expected to provide advantages of economy, efficiency and easier pollution control. The operations of the DRBC are of great significance nationally, since similar actions will have to be taken in many developed regions, but institutions to establish such programs in large river basins are generally lacking. (Whipple-Rutgers)
W70-02694

AN EXAMINATION OF NONTREATEMENT PLANT ALTERNATIVES IN WATER POLLUTION CONTROL
Leonard Ortolano, and Harold A. Thomas, Jr.
Water - 1968, Chemical Engineering Progress Symposium Series, AIChE Vol 64, No 90, p 10-20, (1969).

Descriptors: *Systems Analysis, *Water quality control, *Water pollution treatment, *Water pollution control, Aeration.

Identifiers: Mathematical programming, Instream aeration, Ocean disposal, Removal bottom deposits.

There are a variety of alternative methods for controlling water quality in rivers and estuaries. Where dissolved oxygen is the water quality parameter under consideration, these alternatives include primary sewage treatment plants, secondary sewage treatment plants, tertiary sewage treatment plants, increase in the reaeration coefficient, control of combined sewer overflows, removal of bottom deposits, and piping of wastes outside the basin for ocean disposal. A series of mathematical programming models are presented to investigate the relative merits of these alternatives in a program to maintain a given dissolved oxygen concentration at minimun cost. The Delaware Estuary is used to present sample computations and results. The models are considered as a useful preliminary tool in answering the following questions. Which alternatives should be employed. When (and where) should they be introduced. At what scale should they be operated. (Whipple-Rutgers)
W70-02695

STUDY OF EQUIPMENT AND METHODS FOR REMOVING OIL FROM HARBOR WATERS,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.
Paul C. Walkup, Palmer L. Peterson, Lloyd M. Polentz, Eric H. Phinney, and John D. Smith.
Available from the Clearinghouse as AD-696 980, $3.00 in paper copy, $0.65 in microfiche. Naval Civil Engineering Laboratory Port Hueneme, California, Final Report CR70.001, Aug 25, 1969. 53 p, 14 tab, 28 fig, 56 ref. US Navy Contract N62399-69-C-0028. NCEL Project YF38.534.003.01.002.

Descriptors: *Evaluation, *Oil wastes, Oily water, Water pollution sources.
Identifiers: *Oil spillage, Naval craft (US), Ports and harbors (Hydrological characteristics), Ports and harbors (Geographical characteristics, Ports and harbors (Physical features), Effectiveness, *Cost effectiveness.

A cost effectiveness analysis was performed for equipment, materials, and techniques for the removal of spilled petroleum products from the surfaces of ports and harbor waters used by U.S. Naval craft. Effectiveness criteria, formulated for presently practiced methods and available equipment and materials, included speed, completeness, ease of operation, effect on marine life, and availability. Parameters for the effectiveness study were based on the petroleum products now in use or planned for future use and a detailed review of the geographic, hydrographic, physical and environmental characteristics of ports used by the U.S. Navy. It was found that the two most cost effective systems for broad application were mechanical recovery of spilled material by surface suction devices supplemented by mechanical containment and the application of chemical dispersants by pier or vessel mounted high pressure spray equipment. Recommendations included: the development of additional technology pertinent to petroleum product spills of concern to Naval installation; additional management planning and preparation for coping with spill incidents; installation of equipment at Naval facilities to protect sensitive areas; and support of innovative development activities for improved equipment and methods for coping with petroleum spills.
W70-02725

SOIL AND WATER MANAGEMENT FOR SALINITY CONTROL,
New Mexico State Univ., University Park.
For primary bibliographic entry see Field 02G
W70-02726

CHEMISTRY OF THE OXIDANT, FERRATE, ITS INTERACTION WITH SPECIFIC ORGANICS FOUND IN WASTE WATER,
Kentucky Water Resources Inst., Lexington.
Donald H. Williams.
Available from the Clearinghouse as PB-188 800, $3.00 in paper copy, $0.65 in microfiche. Research Report No 20, Kentucky Water Resources Institute, Lexington, 1969. 13 p, 6 tab, 7 ref. OWRR Project A-008-Ky.

Descriptors: *Oxidation, *Chemical degradation, Waste treatment, Organic wastes
Identifiers: *Ferrate

Techniques for the preparation of potassium ferrate were reviewed and mechanical improvements made which allowed increased yields in shorter times. Relative rates of oxidation of a number of alcohols and other organic compounds were determined in 8M and 0.12 M KOH, and in a solution buffered to pH 8.04 with phosphate. The objective was to determine if the ferrates could be used to oxidize organic pollutants in water. Based on the results of this study, it must be concluded that such a process does not appear to be highly effective for dilute solutions.
W70-02738

EXAMINATION INTO THE EFFECTIVENESS OF THE CONSTRUCTION GRANT PROGRAM FOR ABATING, CONTROLLING, AND PREVENTING POLLUTION, B-166506, FEDERAL WATER POLLUTION CONTROL ADMINISTRATION.
General Accounting Office, Washington, D.C.

Available from the Comptroller General of the US, General Accounting Office, Washington, DC, for $1.00 per copy. Report to the Congress, General Accounting Office, Washington, DC, 1969. 164 p.

Descriptors: *Pollution abatement, *Water pollution control, *Benefits, Water pollution, Water quality, Systems analysis.
Identifiers: Centralized waste treatment systems.

The General Accounting Office (GAO) has examined into the effectiveness of the construction grant program of the Federal Water Pollution Control Administration (FWPCA), which is directed toward abating, controlling and preventing water pollution. During FY 1957-69, FWPCA awarded grants of about $1.2 billion for the construction of some 9,400 projects having a total estimated cost of about $5.4 billion. These projects have contributed to abating water pollution, but less effectively than they might have, since in many cases other major polluters nearby continued to discharge untreated or inadequately treated wastes. The program has been administered by awarding contracts on a readiness-to-proceed basis. Little consideration has been given to the immediate benefits to be received. GAO believes that the present level of Federal funding is inadequate to achieve a significant increase in the effectiveness of the program. Systems analysis techniques and evaluation of benefits are recommended. Planning should be conducted on a river basin basis, or by a single state agency for all of the state. There is also a criticism of the Dept. of Interior's minimum standard of secondary treatment for all effluents. Comments on the findings by the FWPCA are included, and are of interest. (Whipple-Rutgers)
W70-02743

COMBATING POLLUTION CREATED BY OIL SPILLS, VOLUME I: METHODS,
Little (Arthur D.), Inc., Cambridge, Mass
A. V. Pastuhov, S. S. Gray, and A. E. Wechsler.
Available from the Clearinghouse as AD-696 635, for $3.00 in paper copy, $0.65 in microfiche. Washington, DC: US Coast Guard, June 30, 1969. 151 p, 28 tab, 6 fig. Contract DOT-CG-93,374-A

Descriptors: Research and development, *Water pollution control, *Oil, *Cost analysis, Abatement, Absorption, Adsorption, Burning, Biodegradation, Detergents, Dispersion, Disposal, Operations, Equipment, Emulsifiers, Trace elements, Remote sensing
Identifiers: *Recovery equipment, *Containment equipment, Pumps (Vacuum), Air curtains, Booms, Sinking agents, Skimmers

Of primary interest to the professional, this study provides information on the state-of-the-art of available methods for combating oil spills, along with their basic technology. It rates the effectiveness of each method on the basis of technical, ecological, and operational considerations and presents qualitative cost information associated with actual oil spill cleanup operations. Discussed are mechanical removal, physical sinking methods, chemical dispersion, physical absorption, combustion, biological degradation. Because of the undeveloped state-of-the-art of the various combatant methods, the indicated costs in the cost analysis are not so much quantitative measures as they are comparative ones. (Koburger-US Coast Guard)
W70-02744

PHOSPHORUS BUDGETS OF LAKES SIDNEY LANIER AND HARTWELL, GEORGIA,
Georgia Univ., Athens. Biological Sciences Div.
Donald C. Scott.
Project Termination Report, University of Georgia, Jan 1970. OWRR Project A-011-GA.

Descriptors: *Phosphorus, *Iron, *Organic nutrients, *Ions (Sulfide), Reservoir ecology, Sulfides, Manganese, Filtration, Limnology, Anaerobic conditions.
Identifiers: *Lake Sidney Lanier (Ga), *Lake Hartwell (Ga)

The purpose of the research was to compare the animal cycles of phosphorus, iron, and functionally related elements in two large man-made impoundments, Lakes Sidney Lanier and Hartwell, Georgia. The research was expected to yield information on the effects of organic pollution that would be useful in management of other large impoundments and a base for comparison of future developments at the lakes. An analytical research laboratory was established to provide quantitative data on the various forms of phosphorus, iron, and functionally related elements. Laboratory procedures involving millipore filtration and persulfuric acid were developed to separate phosphorus and iron into its several forms for quantitative analysis by standard techniques. Much effort was expended to develop an improved technique for the quantitative determination of the sulfide ion. Precipitation techniques and sulfide stabilization methods were investigated and the results indicated that these techniques showed promise for accurate analysis when applied to samples in the field, providing stability for subsequent laboratory analysis. Termination of the research prevented further development. (Conway-Georgia Tech).
W70-02752

BUOYANCY AND SINKING CHARACTERISTICS OF FRESHWATER PHYTOPLANKTON,
Rhode Island Univ., Kingston.
Theodore J. Smayda.
Technical Completion Report, Rhode Island Water Resources Center, 1969. 7 p. OWRR Project B-006-RI.

Descriptors: *Flotation, *Sinking, *Phytoplankton, *Diatoms, *Blue-green alga, Copper sulfate.

The sinking rates of selected freshwater phytoplanktons were determined. The species were the diatoms Asterionalla formosa, Tabellaria flocculosa, and the blue-green alga Aphanizomanon flos-aquae. The sinking rates of some brackish-coastal water diatoms which have morphological homologues in freshwater were also investigated to examine the influence of morphology on sinking rate. Sinking rates of the freshwater forms used

vere found to approximate those (approximately .2 to 1 meters day-1) for marine phytoplankters. ncreased culture age and colony (Chain) size avored increased sinking rates. Sinking could be eightened by the addition of CuSO4, formalin and I. Killing by heat also heightened sinking. The ad- ition of 0.1% butanol and isopropanol also eightened sinking of the diatoms used, but only he butanol treated blue-green alga cells responded husly. These algae remained viable despite the al- ohol treatment. Their heightened sinking rate and, conversely, therefore one of their suspension ides) appears to related in toto (or primarily) to a hange in total cell density due to osmotic disrup- ions and/or disturbance of the cell membrane elec- rokinetics which can influence the hydrofuge or ydrophilic properties of the cell. The results with CuCO4 addition suggest that in addition to control f noxious water blooms through growth cessation y this agent, sinking of certain phytoplankters may lso be promoted leading to settling out of the rophogenic zone into the aphotic layers where emineralization occurs.
W70-02754

EVALUATION OF FACTORS AFFECTING STREAM SELF-PURIFICATION,
Washington State Univ., Pullman.
Donald E. Proctor.
Available from the Clearinghouse as PB-188 903, $3.00 in paper copy, $0.65 in microfiche. Final Report, Washington State Univ, College of Engineering, Bulletin 316, 1969. 39 p, 11 fig, 5 tab, 4 ref. OWRR Project A-008-WASH.

Descriptors: *Self-purification, *Stream models, Residence age, *Attached growth, *Tracers, Water quality, Streams.

Four identical parallel-flow models were constructed to simulate certain characteristics of flowing streams in order to evaluate self-purification processes. The models were maintained at nearly constant temperature and housed to prevent photosynthesis. Each model consisted of 28 sequentially connected, rectangular, plastic basins equipped with paddle agitators. The relationships of residence age of water at any point in the model to flow rates was determined both theoretically and empirically. The relationships agreed quite closely. The longitudinal dispersion of a tracer through the models is high but quite predictable using derived equations. The ratio of liquid volume to wetted surface area (i. e. effective stream depth) was very low. This resulted in a predominance of metabolic activity by attached organisms and a high degree of self-purification in the first few basins of any model. Substrate biodegradability, as indicated by k values for BOD exertion, changed significantly and rapidly as flow progressed through the models. Self-purification response to copper sulfate fed as a possible toxicant indicated a retardant effect that persisted beyond the wash-out period for the toxicant.
W70-02758

DESIGN OF A COMBINED SEWER FLUIDIC REGULATOR, THE DEVELOPMENT OF BASIC CONFIGURATIONS AND DESIGN CRITERIA FOR APPLICATIONS OF FLUIDS IN SEWER REGULATORS.
Bowles Engineering Corp., Silver Spring, Md.
For primary bibliographic entry see Field 04A.
W70-02773

IMPOUNDMENT INFLUENCES ON WATER QUALITY,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Engineering Section.
James M. Symons, Samuel R. Weibel, and Gordon G. Robeck.
Journal American Water Works Association, Vol 57, p 51-75, Jan 1965. 19 fig, 2 tab, 45 ref.

Descriptors: *Water pollution control, *Streamflow, *Water quality, *Impoundments, Water purification, Simulation, Nitrogen, Water properties, Iron, Manganese, Oxygen requirements.
Identifiers: *Artificial destratification, *Impoundment releases, Simulation tanks, Soil-water contact columns, Impounded water quality.

This paper is concerned with the inadequately studied problem of the quality of impounded water and the practicability of release for stream regulation. Success of this method will require additional research in the systems analysis field, behavior of iron, manganese, nitrogen, phosphorus, and oxygen in impounded environments, influence of physical factors and fertilization, and the effect of impoundment releases on the quality of downstream water. Research now in progress is concerned with small-scale simulation of stratified impoundment and nitrogen transformations. Both thermal and chemical stratification have been accomplished in a 9-foot-high, 500-gal tank. Recorded profile values include temperature, dissolved oxygen, iron, manganese, pH, total hydrolyzable phosphate, and various forms of nitrogen. Nitrogen transformations have been observed in 5-gal glass jars provided with mechanical mixers and sampling siphons. Fortified water supplied vitamins, minerals, amino acids, and ammonium sulfate. The seed was obtained from an activated-sludge plant. Influence of seed variations, concentration of ammonia, and turbulence on dynamics of organic and mineral forms of nitrogen was recorded. A tentative suggestion is made that mechanical aeration may be a more feasible method of stream amelioration than dilution with water carrying 8 parts per million of dissolved oxygen. (Wilde-Wisconsin)
W70-02785

MINES AND MINING.

Pa Stat Ann tit 52, secs 30.51, 30.54, 30.56 (Supp 1969).

Descriptors: *Pennsylvania, *Mining, *Water pollution, *Air pollution, Legislation, Administrative agencies, Administrative decisions, Safety, Mine wastes, Coal mine wastes, Coal mines, Waste dumps, Water pollution sources, Industrial wastes, Mining engineering, Public health, Mine drainage, Dams, Drainage, Ditches, Standards, Water quality.

The operation of a coal refuse disposal pile is prohibited when it fails to comply with the established rules and regulations or quality standards adopted to avoid air or water pollution. Any operator of a coal refuse disposal pile may be ordered to build drainage ditches, trenches and/or gullies, to build impervious dams, to alter locations, to engage in spreading soil, or to use inert sealing materials if some or all of the foregoing are necessary to prevent or correct conditions of air or water pollution. Mine inspectors directed by the Department of Mines and Mineral Industries have the right to inspect and examine any coal refuse disposal area. Conditions which constitute a danger to any person, property, or highways or which fail to meet standards adopted to avoid air or water pollution may be ordered corrected. If there is a failure to comply, the Sanitary Water Board or the Air Pollution Commission may take appropriate actions under existing laws. (Schram-Florida)
W70-02820

SCHUYLKILL RIVER POLLUTION.
Pa Stat Ann tit 32, secs 751.1-751.9 (1967).

Descriptors: *Pennsylvania, *Water pollution control, *Desilting, *Supervisory control (Powers), Water pollution, Administrative agencies, Waste water (Pollution), Water pollution treatment, Abatement, Reservoirs, Levees, Dams, Construction, Dredging, Alteration of flow, Relocation, Area redevelopment, Legislation, Legal aspects, Silting, Silts, Condemnation, Regulation, Highway relocation.

The Water and Power Resources Board of the Department of Forests and Waters is hereby designated to carry into effect the project for the construction of desilting basins in the headwaters of the Schuylkill River and its tributaries to prevent the future silting and pollution of that river. The Board is authorized to: (1) clean out, widen, alter, dredge, deepen or change the course, current, or channel of the Schuylkill River or any of the tributaries; (2) fill up any abandoned canal or watercourse; (3) construct levees, dikes, walls, revetments, dams, reservoirs, and other improvements; and (4) prohibit any dredging operation deemed inimical to the purposes of the act. The Board may sell or lease materials or fill derived from dredging. The Board may enter into agreements with persons or municipalities for relocation of utility or telephone lines, highways, or other facilities. The Board may acquire easements, rights-of-way, or freeholds in carrying out this act, and may use condemnation proceedings under certain circumstances. The Board may obtain cooperation from federal, state, and local agencies. (Kelly-Florida)
W70-02828

CLEAN STREAMS LAW.
Pa Stat Ann tit 35, secs 691.3, 691.4 (1964), as amended, (Supp 1969).

Descriptors: *Pennsylvania, *Water pollution, *Water purification, *Streams, Water pollution effects, Water pollution treatment, Pollution abatement, Water pollution control, Wastes, Public health, Legislation, Water allocation (Policy), Legal aspects, Pollutants, Impaired water quality, State jurisdiction.

The discharge of sewage or industrial wastes or other deleterious substances which are injurious to public health or to animal or aquatic life is hereby declared an unnatural use of such waters and a public nuisance. The legislature has found it a matter of public policy not only to prevent further pollution of the state's waters, but also to reclaim and restore to an unpolluted condition every stream in the state. The Clean Streams Law should be interpreted to fulfill both objectives. (Kelly-Florida)
W70-02832

SEWAGE POLLUTION.
Pa Stat Ann tit 35, secs 691.201-691.210 (1964).

Descriptors: *Pennsylvania, *Water pollution control, *Sewage disposal, *Cities, Permits, Local governments, Public health, Legal aspects, Legislation, Financing, Sewage treatment, Administrative agencies, Supervisory control (Power), Treatment facilities, Pollution abatement, Regulation, Construction, Water quality control.
Identifiers: *Sewer systems, Penalties (Civil).

No person or municipality shall discharge sewage into any waters of the Commonwealth when such discharge is or may become injurious to the public health, animal, or aquatic life. The Sanitary Water Board shall order the discontinuance of existing discharges of sewage by notice in writing, and failure to obey such order within the time provided by the Board is declared a nuisance, punishable by fine and/or imprisonment. Municipalities with a sewer system which discharges sewage into the waters of the Commonwealth shall file a report of such sewer system upon written request of the Board. Municipalities may apply to the Board for a permit to discharge sewage into the waters of the Commonwealth. A permit may be granted if the Board finds such discharge is necessary and not injurious to the public health. All plans and relevant data for the construction of new sewer systems or the extension of existing sewer systems must be submitted to and approved by the Board. Municipalities may issue bonds to cover the costs of acquiring, constructing, or altering such sewer systems or sewage treatment plants as are required by the Board. (Sisserson-Florida)
W70-02833

FISH CONSERVATION.

Wis Stat Ann secs 29.283, 29.286, 29.288, 29.29 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Fish conservation, *Water pollution effects, *Fishkill, Legislation, Legal aspects, Conservation, Structures, Regulation, Nets, Administrative agencies, Ice fishing, Water pollution, Solid wastes, Explosives, Poisons, Pesticide toxicity.
Identifiers: Fish traps, Penalties (Civil), Penalties (Criminal).

The Conservation Commission will establish regulations governing the use of buildings, vehicles, tents, fish shanties, and similar shelters for fishing through the ice in the waters of the state. No person shall have in his possession any net or fish trap capable of taking, catching, or killing fish in specified counties. Whoever deposits, places, or throws into any waters of the state, or leaves on the ice thereof, any solid waste material will be subject to criminal penalties. The use and possession of explosive or stupefying substances in the waters of the state is prohibited, with specified exceptions. Violation of this provision will result in criminal penalties. No person will use, set, lay, or prepare in the waters of the state any substance deleterious to fish life other than such substances deposited in accordance with plans approved by the Committee on Water Pollution. No person will disperse any toxic insecticide in forest or non-crop areas in amounts sufficient to be of possible danger to the health of persons or wildlife. (Keith-Florida)
W70-02836

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

OPERATIONS RESEARCH STUDY OF WATER RESOURCES DEVELOPMENT AND MANAGEMENT OF THE TUCSON BASIN,
Arizona Water Resources Research Center, Tucson.
Chester C. Kisiel, and Lucien Duckstein.
Available from the Clearinghouse as PB-188 797, $3.00 in paper copy, $0.65 in microfiche. Arizona Water Resources Research Center, Project Completion Report, Dec 1969. 27 p, 10 ref. OWRR Project A-010-ARIZ.

Descriptors: *Income analysis, *Operations research, *Pricing, *Water allocation, Computer models, Information retrieval, Model studies, Monte Carlo method, Numerical analysis, Parametric hydrology, Simulated rainfall, Synthetic hydrology, Time series analysis, Economic efficiency, Elasticity of demand, Economic prediction, Water rates, Water requirements, Water demand, Future planning, Water quality controls, Waste dilution, Oxygen sag, Natural recharge, Groundwatermining, Thunderstorms, Ephemeral streams.
Identifiers: *Econometric models, Arizona, Systems hydrology, Simulation of aquifers, Streamflow, and thunderstorm sequences, Water quality management.

The research objective was to undertake a systematic application of tools of operations research to problems of water resource management in metropolitan Tucson, Arizona. Concepts of general systems theory served as a basis for structuring the research and reviewing literature and were explicitly applied in the formulation of a simulation model for water quality management. Physical models were developed for the following processes: natural recharge from an ephemeral stream, point thunderstorm precipitation, and groundwater movement for the Tucson aquifer. Constraints on data availability were revealed by the econometric model of residential water consumption as a function of median family income. The major result of the study was development of a pricing model for optimal allocation of Tucson's groundwater, Colorado River water, reclaimed waste water and Avra Valley groundwater to municipal, industrial, and agricultural use. The objective function was formulated to maximize net revenues to a central water resource agency (presently not in existence) in the face of availability, requirements and social constraints. Actual data was used to obtain opportunity costs associated with mining or conserving Tucson's groundwater. A final result is an economic calculus model to study the influence of water price structure on collective utility of water
W70-02680

STOCHASTIC BASIS FOR COMPREHENSIVE RIVER BASIN PLANNING: PHASE I,
Union Coll., Schenectady, N.Y. Water Resources Research Group.
Fred G. Haag, Keith W. Bedford, Joseph W. Fischetti, and James D. Lloyd.
Available from the Clearinghouse as PB-188 798, $3.00 in paper copy, $0.65 in microfiche. Report, Water Resources Research Group, Union College, 1969. 49 p. OWRR Project C-1318.

Descriptors: *Mathematical models, *Systems engineering, Computer models, Monte Carlo methods, Optimization.

Results are given from Phase I of a study of the application of stochastic systems analysis to water resources problems. An extensive digital computer program was written to simulate the dissolved oxygen-biochemical demand dynamics in a river basin. The unsteady hydraulic equations were included in the model. Preliminary results indicate that the computer times required for simulation of an entire river basin will be impractical (on a GE415 computer). Migration of salinity in the Hudson River estuary was simulated on a digital computer when the calculated results were compared with U.S. Geological Survey data, the agreement was encouraging. A digital computer program was written to calculate the statistical parameters needed for a linear regression synthetic stream flow generator. Recommendations are given for Phase II.
W70-02681

AN EXAMINATION OF NONTREATEMENT PLANT ALTERNATIVES IN WATER POLLUTION CONTROL
For primary bibliographic entry see Field 05G.
W70-02695

EXAMINATION INTO THE EFFECTIVENESS OF THE CONSTRUCTION GRANT PROGRAM FOR ABATING, CONTROLLING, AND PREVENTING POLLUTION, B-166506, FEDERAL WATER POLLUTION CONTROL ADMINISTRATION.
General Accounting Office, Washington, D.C.
For primary bibliographic entry see Field 05G.
W70-02743

6B. Evaluation Process

THE ECONOMIC IMPACT OF IRRIGATED AGRICULTURE ON THE ECONOMY OF NEBRASKA,
Nebraska Univ., Lincoln. Dept. of Economics.
For primary bibliographic entry see Field 03F.
W70-02479

A DECADE, RESEARCH IN LAND AND WATER MANAGEMENT, 1957-1967,
Institute for Land and Water Management Research, Wageningen (Netherlands).
C. Van den Berg, W. C. Visser, J. Wesseling, J. F. Bierhuizen, and G. P. Wind.
Inst Voor Cultuurtechniek en Waterhuishouding Tech Bull No 60, 1968. 91 p, 45 fig, 7 tab.

Descriptors: *Water resources development, *Research and development, *Drainage, *Irrigation, *Land management, Water management (Applied), Irrigation water, Groundwater, Surface waters, Model studies, Mathematical models, Systems analysis, Hydrology, Hydraulics.
Identifiers: *Netherlands, *Water resources research.

Water and land management research in the Netherlands between 1957 and 1967 is summarized. Topics of study include hydrological model studies, research techniques, general hydrology of the Netherlands, groundwater flow, land drainage, soil water, polders, irrigation, soil improvement, and rural development. Hydrological research in the Netherlands has a tendency to include more complex investigations and to integrate research of various disciplines to solve the problems of providing one of Europe's most densely populated regions with a high standard of living. (Knapp-USGS)
W70-02495

GREAT LAKES BASIN COMPACT.

Pa Stat Ann tit 32, secs 817.1-817.6 (1967)

Descriptors: *Pennsylvania, *Great Lakes region, *Interstate commissions, Water resources development, Interstate compacts, Great Lakes, Navigation, Wildlife, Fish, Soil erosion, Soil conservation, Diversion, Water levels, Water policy, St. Lawrence River, Fishing, Natural resources, Regulation, Legal aspects, Administrative agencies, Water pollution.

The Great Lakes River Basin Compact is designed to promote the development and conservation of the water resources of the Great Lakes Basin. The Great Lakes Commission, as created under the compact, will exercise jurisdiction over so much of the following bodies of water as is included within the signatory states: Lakes Erie, Huron, Michigan, Ontario, St. Clair, and Superior; the St. Lawrence River; and all rivers, ponds, lakes, and other watercourses connecting with the St. Lawrence. The composition of the Commission is hereby established. The signatory states agree to consider the Commission's recommendations with respect to lake levels, pollution, navigation, fishing and wildlife resources, soil erosion, and diversion of waters from and into the basin. Any state may withdraw from the compact after six months notice. (Kelly-Florida)
W70-02540

BRANDYWINE RIVER VALLEY COMPACT.
Pa Stat Ann tit 32, sec 818 (1967).

Descriptors: *Pennsylvania, *Interstate compacts, *Water supply, *Water resources development, Water conservation, Flood control, Dams, Reservoirs, Construction, Dam construction, Rivers, Recreation, Parks, Financing, Flow augmentation, Legislation, Legal aspects, State governments, Administrative agencies, Operation and maintenance, Delaware, United States, On-site investigations.
Identifiers: Brandywine River.

The Governor is authorized to enter into a compact on behalf of the state for the purpose of joint and cooperative action to promote the orderly development of water resources in the Brandywine Creek Valley for water supply, quality improvement, flood prevention and control, watershed protection, conservation, and recreation. The Department of Forests and Waters is authorized to construct and operate dams and reservoirs on the Brandywine Creek and its tributaries, to maintain state parks at the dam sites, and to cooperate with the state of Delaware in financing dams and low flow augmentation of the creek at the state boundary line. The Department is also empowered to cooperate with and receive funds from the United States government, to supply water to certain areas, and to permit on-site inspections of dam and

reservoir operation by the State of Delaware and local interests in Pennsylvania. (Kelly-Florida)
W70-02541

INLAND WATERWAY TRANSPORTATION, STUDIES IN PUBLIC AND PRIVATE MANAGEMENT AND INVESTMENT DECISIONS,
Resources for the Future, Inc., Washington, D.C.
Charles W. Howe, Joseph L. Carroll, Arthur P. Hurter, Wm. J. Leininger, and Steven G. Ramsey.
Resources for the Future, Inc, Johns Hopkins Press, Baltimore, Md, 1969. 144 p.

Descriptors: *Inland waterways, *Evaluation, *Economic efficiency, Transportation, Economics, Technology.
Identifiers: Optimum level of investment, Optimum level of traffic.

Economic aspects of inland waterways transportation have been relatively little explored. This study summarizes information available and outlines a theoretical economic efficiency model for waterway investment and management. Aspects covered include technology and production functions for the two, returns to scale for the firm, determination of equipment requirements for the bargeline, traffic flow and congestion simulation, and the demand for inland waterway transportation. This demand model can be used to analyze effects of changes in specific demands for barge transportation. The results of this study should facilitate further research into major problems of government policy related to inland transportation. (Whipple-Rutgers)
W70-02700

A COMPREHENSIVE STUDY OF THE USE TAX AS A MEANS OF ALLOCATION OF WATER RESOURCES IN A CONJUNCTIVE USE SYSTEM,
California Univ., Davis. Dept. of Political Sciences.
For primary bibliographic entry see Field 06C.
W70-02757

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

OPERATIONS RESEARCH STUDY OF WATER RESOURCES DEVELOPMENT AND MANAGEMENT OF THE TUCSON BASIN,
Arizona Water Resources Research Center, Tucson.
For primary bibliographic entry see Field 06A.
W70-02680

A COMPREHENSIVE STUDY OF THE USE TAX AS A MEANS OF ALLOCATION OF WATER RESOURCES IN A CONJUNCTIVE USE SYSTEM,
California Univ., Davis. Dept. of Political Sciences.
Louis F. Weschler.
Available from the Clearinghouse as PB-188 917, $3.00 in paper copy, $0.65 in microfiche. Technical Completion Report WRC 180, California Water Resources Center, Nov 1969. 3 p. OWRR Project A-025-CAL.

Descriptors: *Use rates, Water allocation, Resource allocation, Costs, *Conjunctive use, *Cost comparisons, *Cost allocation.

An important problem in areas which have both ground and surface water supplies is management of the conjunctive system so each supply is devoted to its best use. In California, some local water districts have been authorized to levy a production or use tax on groundwater production; it could serve as a means of rational allocation of water resources among users and uses. None of the four water districts included in this project applied the use tax in a manner to secure optimal use of alternate water sources. The main restraints were found to be opposition to the use by important economic interests, legal constraints contained in California law restricting variations in taxes, and misunderstanding of the potential of the use tax by public officials of the districts. A model of idealized water supply, demand, cost, use and allocation was established for each district. Three projections, 1950-80, were established to compare with this model: actual patterns, trends based upon actual patterns, and hypothetical trends excluding use tax operations. It was found that in spite of wide variations in actual practice and suboptimal performance by all districts that the use tax is useful. In all four districts the relative distribution of ground and surface water to different uses was improved by the operations of the use tax. Thus, the tax does encourage rational planning and use.
W70-02757

6D. Water Demand

WATER FOR INDUSTRIAL DEVELOPMENT IN COVINGTON, JEFFERSON DAVIS, LAMAR, LAWRENCE, MARION, AND WALTHALL COUNTIES, MISSISSIPPI,
Geological Survey, Jackson, Miss. Water Resources Div.
For primary bibliographic entry see Field 03E.
W70-02478

THE LAW OF SURFACE WATER IN MISSOURI,
For primary bibliographic entry see Field 04A.
W70-02577

6E. Water Law and Institutions

LEGAL AND ECONOMIC ASPECTS OF SALT-WATER ENCROACHMENT INTO COASTAL AQUIFERS,
Bookman and Edmonston, Glendale, Calif.
For primary bibliographic entry see Field 02L.
W70-02492

REGULATION OF HUNTING AND FISHING IN INTERSTATE WATERS.

Wis Stat Ann secs 29.085, 29.09 (1) (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Regulation, *Fishing, *Permits, Hunting, Trapping, Conservation, Wildlife conservation, Administrative agencies, Legislation, Legal aspects.
Identifiers: *Interstate waters, *Inland waters.

The Conservation Commission is authorized to regulate hunting and fishing on all interstate boundary waters and specified outlying waters. Except as expressly provided, no person will: (1) hunt any wild animal; (2) trap any game; or (3) take, catch, or kill fish or fish in inland waters of the state without a license. (Keith-Florida)
W70-02502

INTERSTATE COMMERCE - NAVIGABLE RIVERS - INDUSTRIAL WASTE CLOGGING CHANNEL HELD NOT UNLAWFUL OBSTRUCTION - UNITED STATES V REPUBLIC STEEL CORP (7th CIR 1959).
For primary bibliographic entry see Field 05G.
W70-02512

REMARKS BY CONGRESSMAN WILLIAM C. CRAMER BEFORE THE 56TH ANNUAL CONVENTION, NATIONAL RIVERS AND HARBORS CONGRESS.
For primary bibliographic entry see Field 05G.
W70-02513

PREVENTION OF POLLUTION.
For primary bibliographic entry see Field 05G.
W70-02514

DRAINAGE RIGHTS.
For primary bibliographic entry see Field 04A.
W70-02515

CLAIMS AGAINST AND CONTRACTS WITH OTHER DISTRICTS AND MUNICIPAL CORPORATIONS EXERCISING DRAINAGE POWERS.
For primary bibliographic entry see Field 04A.
W70-02516

BAER V BD OF COUNTY COMM'RS OF WASHINGTON COUNTY.
For primary bibliographic entry see Field 04C.
W70-02517

WATER CONSERVATION AND RECLAMATION FUND.
For primary bibliographic entry see Field 05G.
W70-02518

UNLAWFUL ENTRY UPON RESERVOIRS, PONDS, AND DAMS.

Pa Stat Ann tit 35, sec 2106 (1964).

Descriptors: *Pennsylvania, *Dams, *Reservoirs, *Reservoir operation, Standing waters, Water resources, Water supply, Ponds, Reservoir storage, Structures, Electric power production, Impounded waters, Legislation, Legal aspects, Reservoir sites, Administrative agencies, Supervisory control (Powers), Regulation.
Identifiers: Trepass.

The Water and Power Resources Board of the Department of Forests and Waters may post signs prohibiting entry upon any dam, breast, ramp, power house or other structure located on a navigable public stream or river, or upon the pond or reservoir created by such structure. The structures may be owned by private individuals, corporations, or political subdivisions of the state. The primary purpose of such structures must be for the generation, manufacture, transportation, and distribution of electricity, or for the storage of water for domestic, industrial, or water power purposes. Anyone entering upon these properties without permission from the Board during a period of national emergency or war may be tried in a summary proceeding and sentenced to fine or imprisonment upon conviction. (Kelly-Florida)
W70-02519

PETITION TO COURT FOR DRAINAGE AND APPOINTMENT OF COMMISSIONERS.
For primary bibliographic entry see Field 04A.
W70-02520

SOIL CONSERVATION POLICY.
For primary bibliographic entry see Field 04D.
W70-02521

POLLUTION OF DRINKING WATER.
For primary bibliographic entry see Field 05F.
W70-02522

STREAM BOUNDARIES.

Pa Stat Ann tit 53, sec 65301 (1957).

Descriptors: *Pennsylvania, *Boundaries (Property), *Navigable rivers, *Cities, Local governments, Navigable waters, Boundary disputes, Legal aspects, Rivers, Streams, Water rights, Legislation.

Whenever two townships are both bounded by the nearest margin of a navigable stream, the middle of such navigable stream shall be the boundary between the two townships. (Smith-Florida)

W70-02523

CITIES' POWER OVER WATERCOURSES.
For primary bibliographic entry see Field 04A.
W70-02524

CITIES OF THE SECOND CLASS: POWERS RELATING TO LEVEES, FERRIES, WHARVES, CHANNELS, PIERS, AND INFLUENT PIPES.
For primary bibliographic entry see Field 04A.
W70-02525

INTERFERENCE WITH DRAINAGE FACILITIES.
For primary bibliographic entry see Field 04A.
W70-02526

LEASING STATE FORESTS FOR WATER POWER.
Pa Stat Ann tit 32, secs 136-137 (1967).

Descriptors: *Pennsylvania, *Forests, *Leases, *Water resources development, Contracts, State governments, Forest management, Natural resources, Land resources, Water resources, Resource development, Administration, Administrative agencies, Steam, Electric power, Thermal power, Hydroelectric plants, Electric power production, Public utilities, Reservoirs, Canals, Obstruction to flow, Pipelines, Conduits, Condensation.

The Department of Forestry, with the approval of the Governor and Attorney General, is authorized to lease for not more than fifty years any portions of this state's forests for the following purposes: dams and other water obstructions, reservoirs, canals, pipe lines, and other water conduits for the development of water power by steam condensation or otherwise. Every such lease shall contain such terms as are necessary to protect the present and future interests of this state and its people including an option in the Commonwealth to renew the lease or to take over such project works upon payment of the actual net investment in such work. (Smith-Florida)
W70-02527

REGISTRATION AND ADOPTION OF 'MARK' AS IDENTIFICATION OF LUMBER UPON THE ALLEGHENY RIVER.
Pa Stat Ann tit 32, sec 575 (1967).

Descriptors: *Pennsylvania, *Lumbering, *Regulation, Legislation, Flotsam, State governments, Administration, Tributaries, Local governments, Legal aspects, Management, Permits, Rivers.

Any person engaged in lumbering upon the Allegheny River or its tributaries in McKean County must adopt one mark of designation. This mark is to be placed on all spars, logs, masts, or other lumber intended to be floated in the River. Other marks may be used but only in addition to the mark of designation. It is the duty of the prothonotary of the court to file and record such marks as are adopted. The certificate of filing is prima facie evidence of the right of the person filing to use such mark. The right to the use of any mark shall depend on priority of registration. The purpose of this act is that no two persons or companies shall use the same mark. (Barnett-Florida)
W70-02528

APPROPRIATION AND CONDEMNATION OF LANDS AND WATERS TO ENABLE COMPLETION OF AUTHORIZED PROJECTS.
Pa Stat Ann tit 32, sec 623 (1967).

Descriptors: *Pennsylvania, *State governments, *Public utilities, Legislation, Regulation, Administration, Permits, Management, Electric power production, Water supply, Legal aspects, Condemnation, Appropriation, Administrative agencies.

Any public service company holding a limited power permit or a limited water supply permit, granted on behalf of a project for use in public service, shall have the right and power to condemn and appropriate any lands, waters, and other property. Such appropriation is subject to a finding of the Commission after due notice and hearing, that the action is necessary for the maintenance of the project for which the permit was issued. Also, such appropriation must not be incompatible with the public interests of the region in the vicinity of the project. The Commission has been renamed the Water and Power Resources Board, 71 Pa Stat Sec 12 (1967). (Barnett-Florida)
W70-02529

UNDERGROUND WATER DEVELOPMENT.
Pa Stat Ann tit 32, secs 645.1, 645.4-645.13 (1967).

Descriptors: *Pennsylvania, *Water wells, *Well permits, *Water conservation, Wells, Drilling, Groundwater, Water sources, Water supply, Permits, Well regulations, Regulation, Administration, Conservation, Water resources development, Resources, Natural resources, Administrative agencies.

Whereas the renewable natural resource of underground water must be developed in an orderly and reasonable manner, it is the policy of this state to encourage such development. A license shall be required to drill water wells, except for farming or residential uses. The Department of Internal Affairs may require any abandoned well to be sealed. A described application shall be made before any license is issued. A license shall be required for any drilling rig. The Department is empowered to revoke or suspend licenses for fraud in obtaining the same or failure to file reports or maintain records required by this act. Each licensee is required to keep a record of each well setting forth certain information. Failure to comply with these provisions is punishable by fine or imprisonment. The Department is authorized to effectuate the provisions of this act and to adopt rules and regulations. (Smith-Florida)
W70-02530

FLOOD CONTROL.
For primary bibliographic entry see Field 04A.
W70-02531

REFORESTATION SURVEY.
For primary bibliographic entry see Field 04D.
W70-02532

UNITED STATES PROJECTS.
Pa Stat Ann tit 32, secs 678.1-678.2 (1967).

Descriptors: *Pennsylvania, *Flood control, *Flood protection, *Flooding, Flood damage, Federal government, State governments, Local governments, Highways, Bridges, Check structures, Administrative agencies, Construction, Legislation, Legal aspects, Channel improvement, Dredging, United States.

The Commonwealth and its political subdivisions may grant easements to the United States and may enter into agreements with the federal government or its agencies concerning certain aspects of flood control. In any case, where the United States has commenced or finished any work on or construction of a retarding dam, channel improvement, or other flood control project in relation to any river, stream, or creek in the state, the authorized federal representatives may secure easements in highways or bridges when such action is necessary for the project's successful operation and for the safety of life and property. Rights which may be granted include: the right to flood any highways, bridges, or viaducts for temporary periods; the right to enter said highways and lands bordering them to widen rivers or streams or to erect structures upon such lands; and the right to relocate roads, bridges, viaducts, and other public works. (Kelly-Florida)
W70-02533

OBSTRUCTIONS NOT TO BE MADE OR ALTERED WITHOUT CONSENT.
For primary bibliographic entry see Field 04A
W70-02534

POTOMAC RIVER POLLUTION.
For primary bibliographic entry see Field 05G.
W70-02535

PYMATUNING SWAMP DAM.
For primary bibliographic entry see Field 04A.
W70-02536

LOCATION AND IMPROVEMENT OF RIVERS AND STREAMS.
For primary bibliographic entry see Field 04A.
W70-02537

POLLUTION OF WATERS.
For primary bibliographic entry see Field 05G.
W70-02538

OHIO RIVER VALLEY WATER SANITATION COMPACT.
For primary bibliographic entry see Field 05G.
W70-02539

GREAT LAKES BASIN COMPACT.
For primary bibliographic entry see Field 06B.
W70-02540

BRANDYWINE RIVER VALLEY COMPACT.
For primary bibliographic entry see Field 06B
W70-02541

PENNSYLVANIA FISHING REGULATIONS APPLYING TO INLAND WATERS AND BOUNDARY LAKES.
Pa Stat Ann tit 30, secs 10-100 (1958), as amended, (Supp 1969).

Descriptors: *Pennsylvania, *Fishing, *Fishing gear, *Fish management, Fish, Regulation, Administrative agencies, Legislation, State governments, Lakes, Inland waterways, Farm ponds, Bait fishing, Commercial fishing, Fly fishing, Sport fishing, Baits, Fish conservation, Sport fish, Nets, Permits, Fish harvest, Legal aspects, Fish types, Boats. Identifiers: Sturgeon.

Pennsylvania fishing regulations pertaining to inland waters include provisions concerning: (1) definitions of game fish, bait fish, fish bait, and regulated fishing lake; (2) closed seasons; (3) legal sizes; (4) creel limits on fish and fish bait; (5) net permits; (6) devices to catch game fish, bait fish and fish bait; (7) fishing in farm fish ponds; (8) licensing by the Pennsylvania Fish Commission and the necessity for licenses; and (9) penalties. Fishing regulations pertaining to boundary lakes include provisions concerning: (1) definitions of boundary lake, bay, peninsular waters, game fish, fish bait, bait fish, and food fish; (2) fishing devices; (3) creel limits; (4) closed seasons; (5) fish not to be used for fertilizers; (6) sturgeon; (7) rules, regulations, and powers of the Pennsylvania Fish Commission; (8) boat and net licenses; (9) the securing of spawn; (10) licenses to non-residents; (11) meshes of nets, licensing and use thereof; (12) legal size and weight of fish and fillets; (13) minnow nets; and (14) penalties. (Marsee-Florida)
W70-02542

POLLUTION: TRESPASS ON STATE HATCHERIES.
For primary bibliographic entry see Field 05G.
W70-02543

MISCELLANEOUS PROVISIONS (RELATING TO WATER).
For primary bibliographic entry see Field 05G.
W70-02544

DISCHARGE OF SEWAGE ON OR WITHIN LIMITS OF HIGHWAY.

Pa Stat Ann tit 36, secs 2621-2623 (1961).

Descriptors: *Pennsylvania, *Sewage, *Drainage, *Outlets, Legal aspects, Surface drainage, Highways, Sewage disposal, Discharge (Water), Legislation.
Identifiers: *Penalties (Criminal), Public nuisances.

It is unlawful for any person, association, corporation, or partnership, to discharge sewage or drainage, with the exception of surface drainage, on or within the legal limits of any public highway. It is unlawful to place a sewer outlet within the limits of a public highway or to so locate it that the discharge therefrom enters a public highway. Criminal penalties are provided for violation of either of the foregoing provisions. (Keith-Florida)
W70-02545

DELAWARE RIVER BRIDGES.
For primary bibliographic entry see Field 04A.
W70-02546

DELAWARE RIVER JOINT TOLL BRIDGE COMMISSION.
For primary bibliographic entry see Field 04A.
W70-02547

INDUSTRIAL WASTES.

Pa Stat Ann tit 35, secs 691.301-691.310 (1964), as amended, (Supp 1969).

Descriptors: *Pennsylvania, *Industrial wastes, *Water quality control, *Water pollution control, Administrative agencies, Legal aspects, Legislation, Acid mine water, Waste water treatment, Treatment facilities, Regulation, Public health, Surveys, Investigations, Waste treatment, Discharge (Water), Water pollution sources, Water pollution treatment.
Identifiers: Penalties (Civil).

It is unlawful to discharge industrial wastes into any waters of the Commonwealth unless permission has been given by the Sanitary Water Board. Persons who are discharging industrial wastes into such waters on the effective date of this act shall file with the Board a report including the kind, characteristics, and rate of flow of such discharge. The Board may order such persons to discontinue discharges injurious to the public health or to animal or aquatic life. 'Clean waters' are defined as waters which are, at the effective date of this act, free from any discharge of industrial waste; the Board shall never permit discharge of industrial wastes into such waters unless the wastes have been completely treated. No person shall open an establishment after the passage of this act which will discharge industrial wastes into the waters of the Commonwealth without providing adequate treatment works for the treatment of such wastes. Plans for the treatment works must be submitted to and approved by the Board prior to construction of the works. Violations of these provisions are misdemeanors, punishable by fine and/or imprisonment. (Sisserson-Florida)
W70-02548

PETTY POLLUTION.
For primary bibliographic entry see Field 05G.
W70-02549

DOMESTIC WATER SUPPLIES.
For primary bibliographic entry see Field 05F.
W70-02550

WHARVES, DOCKS, HARBORS.

Pa Stat Ann tit 55, secs 301-302, 311-314, 322 (1964).

Descriptors: *Pennsylvania, *Docks, *Harbors, *Eminent domain, Legislation, Easements, Damages, Compensation, Cost repayment, Condemnation value, Cities, Public benefits, Navigable rivers, Delaware River, Administrative agencies, Administrative decisions, Bulkheads, Piers, Jurisdiction, Legal aspects, Water law.
Identifiers: Warfage, Dockage.

When the owners of wharves, docks, or landings adjoining the Delaware River, not in first class cities, disagree as to the proper apportionment of the wharfage or dockage payable to them, the Board of Commissioners of Navigation shall determine the relative proportions. This shall be done in accordance with the established customs and usages of the port involved, or if there are no such customs, according to justice and equity. Any person may appeal from such a decision to the county court of common pleas. Public landings on any navigable river which have become unnecessary may be taken by eminent domain for public purposes by the city in which they are located. The damages for the taking or injury of any property for use as a public sharf, pier, or bulkhead include full compensation for the value of said property taken and compensation for any damages to the plant. No structure erected pursuant to the provisions of this act may interfere with the general public use of wharves for river commerce. (Schram-Florida)
W70-02569

THE LAW OF SURFACE WATER IN MISSOURI,
For primary bibliographic entry see Field 04A.
W70-02577

DEPARTMENT OF NATURAL RESOURCES.

R I Gen Laws Ann 42-17.1-1 thru 42-17.1-4 (1967).

Descriptors: *Rhode Island, *Natural resources, *State governments, *Administration, Resources, Land resources, Conservation, Forests, Land, Parks, Recreation, Water resources, Wildlife, Water resources development, Resource development, Governments, Legislation, Planning, Regulation, Public utilities, Agriculture, Harbors, Rivers, Development, Fishing, Marshes, Coordination, Supervisory control (Power).

The Department of Natural Resources is established with power and duty to: (1) supervise and control the protection, development, planning, and utilization of the natural resources of the state; (2) exercise all functions, powers, and duties heretofore vested in the Department of Agriculture and Conservation, the Division of Parks and Recreation of the Department of Public Works, or in the Division of Harbors and Rivers of the Department of Public Works; (3) cooperate with the Department of Health in the enforcement of water pollution laws, with the Development Council in its planning and promotional functions, and with conservation commissions of cities and towns. The Department is divided as follows: (1) the Park and Recreation Division with power to establish, operate, and maintain parks and recreation areas; (2) the Conservation Division with the duty to operate, maintain, and preserve forests, natural areas, marsh lands, wildlife areas, hunting and fishing areas; (3) the Agriculture Division, Harbors and Rivers Division, and Planning and Development Division to replace the departments of the same names; (4) the Division of Enforcement which enforces the laws and cooperates with other enforcement agencies. (Smith-Florida)
W70-02584

CONSTRUCTING BRIDGES TO ELIMINATE GRADE CROSSINGS.
Pa Stat Ann tit 15, sec 4112, 4113 (1967).

Descriptors: *Pennsylvania, *Bridges, *Grading, *Highways, Highway relocation, Roads, Civil engineering, Graded, Road construction, Railroads, Bridge construction, Rivers, Streams, Legislation, Legal aspects, Cost allocation, Construction costs, Separable cost allocation.

In order to eliminate grade crossings the Public Service Commission may order that a viaduct or bridge be constructed over, above, and across railroad tracks, rivers, and streams, or that the location thereof be changed to a new place. When a public street or highway is involved, the Public Service Commission may direct that a certain portion of the costs be paid by the Commonwealth. Costs shall be apportioned according to law. (Smith-Florida)
W70-02585

MILL DAMS.
Pa Stat Ann tit 55, secs 291 thru 293 (1964).

Descriptors: *Pennsylvania, *Mill dams, *Mills, *Dams, Legislation, Navigable streams, Dam construction, Damsites, Fish barriers, Fish passages, Boats, Navigation, Sites, Legal aspects, Fish conservation, Fish, Water works, Highways, Roads, Riparian rights.
Identifiers: *Obstruction to navigation, Penalties (Criminal), Penalties (Civil).

Owners of lands adjoining navigable streams may erect dams for mills or other waterworks and lead off so much of the waters of such streams as may be necessary for this purpose. However, such structures may not obstruct or impede the navigation of such stream, prevent the passage of fish, or infringe or injure the rights and privileges of other adjacent landowners. Violators of this chapter may be fined not more than one hundred dollars and may also be made to pay such damages to the person complaining as shall be found by jury. The court must also order every such obstruction removed to comply with the limitations of this act. If the owner of any boat or other vessel suffers damage or is delayed in his passage on any navigable stream by any dams as aforesaid, he may recover such damages from the owner of such dam. (Schram-Florida)
W70-02586

FISH AND GAME LAWS - GENERAL PROVISIONS.

R I Gen Laws Ann secs 20-1-7, 20-1-8, 20-1-10, 20-1-12, 20-1-14, 20-1-17 (1968).

Descriptors: *Rhode Island, *Wildlife conservation, *Wildlife management, *Regulation, Wildlife, Natural resources, Resource development, Fish conservation, Preservation, Hunting, Fishing, Game birds, Waterfowl, Fisheries, Legislation, Massachusetts, Lakes, Permits, Oysters, Shellfish, Commercial fish, Administrative agencies.

The Director of Natural Resources may make rules and regulations governing fishing in Wallum Lake, and he may confer with Massachusetts officials concerning fishing by Massachusetts residents in said lake. The Director is authorized to fix season and bag limits on fresh-water fish. He may appoint and delegate powers to conservation officers for the prosecution of laws relating to fisheries, shellfisheries, wild birds and wild animals. The Director and conservation officers are empowered to: (1) enforce all fish and game laws; (2) execute warrants and issue subpoenas for violations of rules and regulations; (3) take possession of any fish or game taken in violation of this state's laws; and (4) seize all fishing or hunting equipment or licenses used to violate state law. The Director may appoint oyster guards to protect leased oyster grounds and may make all regulations necessary for the enforcement of state shellfish laws. (Smith-Florida)
W70-02589

FREE AND COMMON SHELLFISHERIES.
R I Gen Laws Ann secs 20-9-17 thru 20-9-22, 20-9-26, 20-9-27 (1968).

Descriptors: *Rhode Island, *Administrative agencies, *Fish management, *Crabs, Regulation, Natural resources, Permits, Shellfish, Oysters, Clams, Mussels, Bays, Inlets, Fish reproduction, Legislation, Fish conservation, Conservation, Legal aspects.
Identifiers: *Coves, Quahaugs, Scallops, Penalties (Criminal).

The taking of blue and sand crabs is regulated. Only residents may take such crabs. The Director of Natural Resources may designate waters from which such crabs shall not be taken. Blue crabs may be taken only during the established season. Sex and size limitations are established for blue crabs. Persons violating these provisions are subject to various penalties. Persons taking shellfish at night are subject to fine and imprisonment. Persons trading in shellfish must obtain a license from the Director of Natural Resources. Licenses must deal only with licensed persons. The Director may, after a hearing, suspend licenses for violation of these provisions. License suspensions may be appealed to the superior court. (Duss-Florida)
W70-02590

FISH AND GAME: OYSTER GROUND LEASES.

R I Gen Laws Ann secs 20-10-26 thru 20-10-28, 20-10-30, 20-10-31 (1968).

Descriptors: *Rhode Island, *Oysters, *Beds, Riparian rights, Boats, Leases, Docks, Fish management, State jurisdiction, Regulation, Shellfish, Land tenure, Legislation, Rivers, Aquatic life, Legal aspects, Wildlife conservation, Conservation, Damages.
Identifiers: *Penalties (Criminal), Vessels.

Any person taking oysters from oyster beds at night shall be fined for each offense. Boats and equipment employed in the taking shall be forfeited. Taking oysters from private beds is subject to fine and imprisonment. Persons wilfully damaging private oyster beds shall be fined, and boats and equipment employed shall be forfeited. Persons taking more than two bushels of oysters from Trustan Pond during one day shall be fined. Any constable viewing the commission of these offenses may arrest and detain the offender without warrant. (Duss-Florida)
W70-02591

TOWN CONTROL OF FISHERIES.

R I Gen Laws Ann secs 20-17-1 thru 20-17-4 (1968).

Descriptors: *Leases, Rhode Island, *Shellfish, *Fisheries, Legislation, Ponds, Regulation, Preservation, Riparian rights, Fish, Clams, Oysters, Mussels, Cities, Fish conservation, Shores, Beds, Conservation, Aquatic life, Commercial shellfish, Fish managment, Wildlife conservation, Cultivation, Legal aspects.
Identifiers: Quahaugs, Scallops, Penalties (Criminal).

The electors of Tiverton may make regulations for the preservation of fish and may control the fisheries of Nomquit Pond within the town limits. The electors of New Shoreham may enact ordinances to protect and regulate the taking of shellfish and other fish in Great Salt Pond. Penalties may be imposed for violations of such ordinances. Subject to the rights of riparian owners, the town council of New Shoreham is authorized to regulate shell fisheries in Great Salt Pond by leasing one-acre lots to inhabitants of the state. Such leases are for the protection and cultivation of shellfish. Persons interfering with the rights of lessees or taking shellfish from their grounds without permission shall be fined for each offense. (Duss-Florida)
W70-02592

FISHING LICENSES.

R I Gen Laws Ann secs 20-5-1 thru 20-5-15 (1968).

Descriptors: *Rhode Island, *Fishing, *Permits, *Fish management, Regulation, Control, Fish, Fish conservation, Conservation, Wildlife conservation, Management, Fish guiding, Fishing stocking, Riparian rights, Stream improvement, Wildlife management, Hunting, Water sports, Wildlife, Recreation, Sport fishing, Legislation.

Regulations relating to the issuance of fishing licenses are provided. All money received from license fees is appropriated for: (1) the protection and propagation of fish and game; (2) the leasing of land and rights-of-way to streams and ponds to be stocked with fish; (3) stream improvement; and (4) fish and game law enforcement. The Director of the Department of Natural Resources has jurisdiction over all matters in the chapter and makes all needed regulations for the enforcement of this chapter. (Smith-Florida)
W70-02598

CULTIVATION OF FISH.
R I Gen Laws Ann secs 20-4-9 thru 20-4-15, 20-4-20 (1968).

Descriptors: *Rhode Island, *Fish reproduction, *Fisheries, *Fish management, Fish, Fish hatcheries, Reproduction, Regulation, Fish ladders, Fish passages, Fish migration, Fish guiding, Fish conservation, Wildlife management, Fish barriers, Life cycles, Legislation, Management, Conservation, Wildlife conservation, Administrative agencies, Natural resources, Legal aspects.

For the purpose of protecting and propagating fish and providing public fishing preserves the Director of Natural Resources may acquire any land, stream, lake, pond, or any part thereof upon such conditions as the owner and Director may agree upon. The Director may summarily seize and remove all obstructions to the growth, culture, or passage of fish. It is unlawful to rebuild any such structure or to fish in waters set aside for the cultivation of fish. It is unlawful to catch fish by hook and line from fisheries for three years after such fishery was stocked, except for certain black bass fisheries. An open season is set for waters set aside for shad and salmon cultivation. It is unlawful to use any seine or catch any fish within half a mile of any fishery. The Department may take fish from any fishery for fish culture or scientific observation purposes. The exclusive right to own, cultivate, and control all fish or shellfish in a pond artificially created by excavation shall belong to the proprietors thereof, whether such fish be artificially or naturally propagated. Certain restrictions apply to such cultivation. (Smith-Florida)
W70-02599

VIGILANCE OVER RESERVOIRS.
Gruner Brothers, Basle (Switzerland).
Edward C. Gruner.
Water and Water Eng, Vol 73, No 883, p 369-373, Sept 1969. 5 p, 30 ref.

Descriptors: *Dam construction, *Safety, *Reservoir construction, *Regulation, *Reservoir operation, Flood protection, Damages, Safety factors, Rock mechanics, Instrumentation, Dam failure, Erosion, Nuclear energy.
Identifiers: Dam safety, Reservoir safety.

This article describes in general terms a project on 'Safety of Reservoirs' developed by UNESCO aiming at a diffusion of experience gained on existing dams for further design, construction, modification, operation or removal of dams and reservoirs. The study includes case histories, principles, condensed experience, an abstract of regulations, and a bibliography of water power regulations in France, Italy, Japan, Norway, Spain, Switzerland, USSR, Poland, Czeckoslovakia, United Kingdom, and the USA. (Gabriel-USGS)
W70-02639

LANDS MAY BE GRANTED OR EXCHANGED TO PROMOTE BOATING.

Wis Stat Ann sec 27.115 (1964).

Descriptors: *Wisconsin, *Boating, *Beds, *Sailing, Legislation, Legal aspects, Navigation, Naval architecture, Ownership of beds, Recreation, Recreation facilities, Local governments, Cities, Water sports.
Identifiers: Naval science.

Any city or county which has acquired or may hereafter acquire title to the bed of any lake is authorized to transfer that title to any incorporated yacht club under certain conditions. The principal purposes of a yacht club, in order for it to qualify, must be the development and encouragement of boating, sailing, yacht building, naval architecture and science, and nautical knowledge, customs and beliefs. A city or county may either grant land to the yacht club or exchange for land owned by the yacht club. Such conveyances are valid so long as the yacht club uses the land for the purposes enumerated above. (Keith-Florida)
W70-02682

CULTIVATION OF FISH.

R I Gen Laws Ann secs 20-4-1, 20-4-2, 20-4-5, 20-4-8 (1968).

Descriptors: Rhode Island, Fish hatcheries, *Fish management, Fisheries, Fish populations, Fish establishment, Regulation, Fish, Reproduction, Wildlife conservation, Conservation, Fish conservation, Fish reproduction, Fish stocking, Shellfish, Research and development, Legislation, Administration, State governments, Aquatic life, Aquatic animals, Aquiculture, Inland waterways, Shores, Seashores.

The Director of Natural Resources may make any experiments in cultivating and developing all kinds of shellfish and for such purpose may hold and occupy exclusively any portion of the shores of the public waters or land within the state. The Director may make regulations for the protection of such areas and their animal life. The Department of Natural Resources may introduce, protect, and cultivate fish in the inland waters of the state and may make regulations for the protection of such fish. It is unlawful for any person to violate these regulations or to take any fish, fish spawn, or any apparatus used in hatching or protecting fish, without the consent of the person cultivating the same. (Smith-Florida)
W70-02718

FISHING BY NON-RESIDENTS.
R I Gen Laws Ann secs 20-6-1 thru 20-6-4 (1968).

Descriptors: *Rhode Island, *Fishing, *Trawling, *Permits, Commercial fishing, Fish, Fish harvest, Fishing gear, Equipment, Fish management, Fish conservation, Regulation, Administration, Wildlife management, State jurisdiction, Fishing, Lobsters, Aquatic animals, Commercial shellfish, Bass, Natural resources, Legislation.

No persons except citizens of this state shall take fish with or set any kind of beam or otter trawl in the public waters of this state. In certain locations it is unlawful for any person, firm, or corporation to operate otter trawls or beam trawls. It is unlawful for non-residents to take lobsters, tautog, bass, or other fish away in vessels. Any non-resident who holds a Connecticut fishing license may fish by angling in certain locations without a license from this state, provided such non-resident is subject to all the statutes of this state and provided Connecticut grants like privileges to holders of Rhode Island licenses. A non-resident who is a resident of a state which grants reciprocal privileges to Rhode Island citizens may apply to the Director of Natural

esources for a license to fish by beam or otter awl. The Director may suspend or cancel any ich license when the public interest requires. Smith-Florida)
V70-02732

LLOCATIVE IMPACTS OF FEDERAL AND TATE WATER DEVELOPMENT LAW,
'alifornia Univ., Los Angeles. Dept. of Economics.
'avid L. Shapiro.
'alifornia Water Resources Center, Technical 'ompletion Report WRC No W188, Nov 1969. 3 p. 'WRR Project B-065-CAL.

'escriptors: *Water allocation, *Water rights, Water transfer, Legal aspects, Water resources evelopment.

)ne aspect of the research focused on the interac- ons of California water law and federal water evelopment law. Problems arose out of the dif- culties of transferring water rights in the Central 'alley Project, creating inefficiencies. The second hase of the work involved a search for devices to void such legally created anomalies. One ap- roach was based on the issuance of transferable aper titles, and the second approach was based on he title insurance concept applied to water rights. Either plan, properly implemented, would correct he main impediment to transferability. Another hase of the work concerned improvements in ex- sting water development law. One topic studied oncerned the discount rates used to calculate fu- ure benefits and costs, and the analysis indicated he newly existing rates not sufficiently high. The uthor further suggests the use of incremental enefit-cost analysis. Another approach suggested he policy of having an adversary government agen- y review the work of planning agencies before uthorization.
V70-02736

ROTECTION OF FISHING GROUNDS.
R I Gen Laws Ann secs 20-3-1 thru 20-3-4 (1968).

)escriptors: *Rhode Island, *Fish management, *Tidal waters, *Fishing, Fish, Baits, Boats, Ships,)il wastes, Brines, Oysters, Aquatic animals, Aquatic life, Regulation, Legislation, Conserva- ion, Water conservation, Fish conservation, Water esources development.

t is unlawful to deposit fish offal or water im- regnated with fish in public tidewaters unless fil- ered in accordance with regulations of the town vherein such deposit is to be made. Every vessel sed for procuring fish oil or for dressing bait and ther fish in violation of this chapter shall be liable or all prosecution costs, and such vessel may be at- ached to secure any possible judgment. It is unlaw- ul to press fish for extracting oil on board any ves- el on any public tidewaters. It is unlawful to wil- ully place brush, trees or limbs in any waters of Charlestown Pond, except for the protection and ultivation of oysters. (Smith-Florida)
W70-02737

THE USE OF STREAM CHANNELS TO DELIVER STORED WATER: THE POSSIBILI- TY OF INTERFERENCE BY THIRD PARTIES,
North Carolina Univ., Chapel Hill.
Douglas R. Gill.
Available from the Clearinghouse as PB-188 916, $3.00 in paper copy, $0.65 in microfiche. Report No 32, Water Resources Research Institute of The University of North Carolina, Dec 1969. 34 p North Carolina Project NC-WAR-1.

)escriptors: *Water law, *Riparian rights, Water r[illegible], Water transfer.
dentifiers: Stream channels, Impounded waters.

This report is addressed to one aspect of the adap- ation of old water rights law to contemporary con- ditions: legal issues associated with the use of stream channels to deliver stored water from im- poundments. It identifies three possible threats of interference with these uses of stream channels for transmitting stored water. First: intervening ripari- an land owners might successfully object to the use of the channel for such artificial water carriage. Second: intervening riparian land owners might be able to intercept the released water before it reaches its destination, and without legal recourse by the intended beneficiary of the storage. Third: owners of riparian land situated below the point of intended use may be able to raise enforceable legal objections against a proposed withdrawal for public water supply purposes. Under existing riparian rights law in North Carolina, the report concludes, the first threat is probably insubstantial, while the second and third threats are significant. There may be some possibilities of moderating these risks in some cases via equitable concepts or doctrines of sovereign immunity or inverse condemnation. 'For the long run, however, it is difficult to imagine an efficient stored water system being operated under North Carolina law as it seems presently to exist.' (p 33). The report points to the possibility of legislative solutions, suggesting that further research is needed to explore legal aspects of such solutions, including possible constitutional issues. (Howells-North Carolina)
W70-02765

LEASING OF TOLL BRIDGES.

Pa Stat Ann tit 16, secs 5841, 5852 (1956).

Descriptors: *Pennsylvania, *Bridges, *Leases, *Local governments, Structures, Bridge construc- tion, Construction, Public utilities, Highways, Ju- risdiction, Railroads, Rivers, Streams, Contracts, Maintenance, Public benefits, Legislation.

Whenever a bridge company's toll bridge is used solely by the public for general highway purposes, or concurrently with a public railroad company, the county commissioners of any interested county may lease such bridge or portions thereof for use by the public for general highway purposes and free from the payment of tolls. Where a municipality is authorized to construct a bridge or viaduct over a river, creek, or stream over which the county is also authorized to build such bridges, and such mu- nicipality is authorized to contract with interested parties, railroad companies, or county governments for the construction and maintenance of such structures, the county commissioners with court approval may contract with such municipality for the portion of such structure which the county might have built. (Smith-Florida)
W70-02805

TAKING UP DRIFTING LUMBER.
Pa Stat Ann tit 32, secs 511-518 (1967).

Descriptors: *Pennsylvania, *Lumber, *Boats, *Rivers, Ohio River, Delaware River, Legal aspects, Lumbering, Damages, Riparian rights, Legislation.
Identifiers: Barrels, Oil barrels, Drifting lumber.

Any person may take up lumber of any kind or any flat-boat floating upon the waters of the Ohio, Al- legheny, or Monongahela rivers or any of their tributaries by posting a list and description of such lumber or flat-boat in a conspicuous place in the town or borough where such lumber or flat-boat was found. If the true owner does not call for and take away the same within three months, such lumber or flat-boat shall become forfeited to the person taking up the same. Any person so taking up lumber or flat-boats shall be reimbursed by the owner at set rates, and such person shall be liable for damages for failure to comply with this act. These provisions shall apply to full or empty oil barrels. Persons securing drifting lumber in the Schuylkill or Delaware rivers are entitled to com- pensation from the owner. It is the duty of any per- son in possession of previously drifting lumber to safely store the same, advertise the same in a local newspaper for four weeks, sell the same at public sale, and keep the proceeds for one year. (Smith- Florida)
W70-02806

SUSQUEHANNA AND LEHIGH RIVERS AND THEIR TRIBUTARIES, TREES, LUMBER, AND TIMBER THEREIN.

Pa Stat Ann tit 32, secs 541, 544, 551-552, 559 (1967).

Descriptors: *Pennsylvania, *Lumbering, *Flot- sam, Legislation, State governments, Administra- tion, Islands, Regulation, Tributaries, Legal aspects, Saw mills, Transportation.

Any person finding logs, shingles, boards, or lumber floating in the Susquehanna or Lehigh rivers has a duty to list the quality and quantity of such materials with the court. Publication of the finding shall be made. Unclaimed materials shall be forfeited to the finder. Owners and occupiers of islands in the Susquehanna River may act in accord with the provisions of this act with regard to lumber lodging on said islands. All persons placing lumber in the river above the Susquehanna boom must adopt a mark to be placed on such lumber which is to be registered in writing with the court. Cer- tificates of registration are prima facie evidence of the right to use such marks. No two persons shall have the same mark. All saw logs to be floated down the Susquehanna River between Northum- berland and the Maryland state line must be rafted and joined together or enclosed in boats and under the control and supervision of men thereon. All loose logs are subject to capture and possession un- less the owner makes timely demand and nominal payment for them. (Barnett-Florida)
W70-02807

MUNICIPAL ASSISTANCE.
Pa Stat Ann tit 32, secs 802-806 (1967).

Descriptors: *Pennsylvania, *Local governments, *Financing, *Water conservation, State govern- ments, Costs, Construction costs, Flood control, Flood protection, Water resources development, Legal aspects, Legislation, Projects, Project planning, Administrative agencies, Cities.

Any municipality is authorized to increase its in- debtedness within state-established limits for the purpose of assisting the state in the construction or completion of any project or improvement for water conservation or flood control. Moneys may be appropriated by the municipalities only for ex- penditure on projects authorized by law. The state hereby declares its intention to repay funds ad- vanced by the municipalities for water conserva- tion and flood control projects. The Department of Forests and Waters shall have full power to use and expend funds advanced by municipalities for these purposes. (Kelly-Florida)
W70-02808

FISHING REGULATIONS APPLYING TO BOUNDARY RIVERS.
Pa Stat Ann tit 30, secs 110-158 (Supp 1969).

Descriptors: *Pennsylvania, *Fishing, *Delaware River, *Fishing gear, Fish, Regulation, Fish management, Legislation, State governments, Ad- ministrative agencies, State governments, Rivers, Bait fishing, Commercial fishing, Sport fishing, Fish conservation, Baits, Bait traps, Nets, Legal aspects, Fish harvest, Fish types, New York.

In setting forth fishing regulations applying to Pennsylvania's boundary rivers, this act establishes three differing articles affecting the Delaware River: provisions applying to the river above Trenton Falls; provisions applying to the river below Trenton Falls; and provisions applying to that portion of the river between Pennsylvania and New York. The articles, although varying in sub- stance concern: (1) definitions of game fish, bait

fish, and food fish; (2) permissible fishing devices for game fish, bait fish, and food fish; (3) seining for sturgeon and food fish; (4) stakes and fastened nets; (5) closed seasons for food fish, game fish, the use of nets, and the use of eelpots and fyke nets; (6) legal sizes and creel limits; (7) penalties for damage to nets and seines; (8) the use of nets on Saturdays and Sundays; (9) concurrent jurisdiction of states; (10) the sale of fish; (11) size of mesh for nets and seines; (12) closed seasons on shad; (13) taking fish for bait, scientific and stocking purposes; and (14) seizure of illegal devices. (Marsee-Florida)
W70-02809

DAMS, FISHWAYS, BAR-RACKS, OBSTRUCTIONS.
Pa Stat Ann tit 30, secs 185-196 (Supp 1969).

Descriptors: *Pennsylvania, *Fish passages, *Fish barriers, *Fish migration, Dams, Fish, Fish ladders, Intakes, Fish establishment, Fish stocking, Costs, Fish handling facilities, Fish conservation, Wildlife conservation, Fishing, Sport fishing, Fishing gear, Control, Animal control, Water conservation, Administrative agencies, Legal aspects, Legislation, State governments, Engineering structures.

Persons hereinafter erecting or maintaining dams in state waters must, upon written order from the Pennsylvania Fish Commission, erect such chutes, slopes, fishways, gates, or other devices as are necessary to enable fish to ascend and descend the waters in all seasons. Alternatively the Commission may elect to receive from such persons the sums of money herein specified to be applied to fish stocking and management. The above devices must be maintained in good working order and may be closed for repairs no longer than thirty days at one time. Where the persons notified fail to erect requested devices, the Commission may erect the devices and collect the costs from those persons. The Commission shall pay the cost of installing devices in already existing dams. Drawing off of waters inhabited by fish or interfering with dams requires Commission approval. Fishing near dams and devices except with rod and line and preventing the migration of fish are prohibited. Persons maintaining raceways, flumes, or inlet-pipes leading to a water-wheel, turbine pump, or canal must place bar-racks to prevent fish from entering therein. (Marsee-Florida)
W70-02810

BRIDGES OVER NAVIGABLE WATERWAYS AND RAILROADS.
Pa Stat Ann tit 36, secs 2911-2913 (1961).

Descriptors: *Pennsylvania, *Bridges, *Navigable waters, *Railroads, Navigable rivers, Navigation, Bridge construction, Construction, Bridge design, Dams, Canals, Barriers, Obstruction to flow, Lumbering, Rivers, Streams.

No bridge, frame or device shall be erected or sustained over any navigable waterway if such device in any way hinders the navigation of any craft or float of logs. This shall not limit maintaining and repairing drawbridges and public bridges or the making of dams, mounds, or tide banks for the draining of low grounds and improving meadows. The laws relative to the erection of bridges over rivers and creeks are extended to the erection of bridges over canals and railroads. Bridges shall not obstruct the canal or railroad over which such bridge is erected. (Smith-Florida)
W70-02811

AUTHORITY TO ERECT BRIDGES.
Pa Stat Ann tit 36, secs 2972-2989.49 (1961), as amended. (Supp 1969).

Descriptors: *Pennsylvania, *Bridges, *Rivers, Bridge construction, Streams, Eminent domain, Condemnation, Public lands, Highway relocation, Road construction, Highways, Structures, State governments, Administration, Legislation, Railroads.

The Department of Highways, with the Governor's approval, is authorized to erect bridges at named locations over the Susquehanna, Monongahela, Allegheny, Clarion, Chester, and Schuylkill Rivers and over certain railroad tracks in Altoona. Said Department is authorized to acquire the necessary land for approaches thereto and shall have all powers conferred with respect to relocation, widening or construction of highways. Several of said bridges shall be toll bridges until such time as the costs of constructing or acquiring said bridge shall be paid. The other bridges shall be toll free and maintained by the Department of Highways. (Smith-Florida)
W70-02812

DELAWARE RIVER BRIDGE COMPACT.
Pa Stat Ann tit 36, secs 3511, 3512, 3521 (1961).

Descriptors: *Pennsylvania, *Interstate compacts, *Bridge construction, *Delaware River, Highways, Bridges, Administration, Administrative agencies, Tunnels, Tunnel construction, Tunneling, Underground, Structures, Rivers, Streams, Navigable waters, Navigable rivers, Transportation, Construction, Legislation, New Jersey.

The Governor is authorized to enter into a compact with New Jersey in substantially the following form: The Pennsylvania Turnpike Commission and the New Jersey Turnpike Authority are empowered to locate and make plans for a bridge across the Delaware River to connect the turnpike systems of both states. Said Commission and Authority are empowered to enter into agreements setting forth the details of erecting and maintaining such bridge. Upon coming into force, such Compact shall be binding upon Pennsylvania and the Pennsylvania Turnpike Commission and shall have the force and effect of a statute. The Governor shall appoint three citizens to the Delaware River Bridge and Tunnel Commission to plan and construct one or more bridges or tunnels as may be necessary for traffic over or under all navigable streams or rivers which streams or rivers are boundaries of this state. (Smith-Florida)
W70-02813

DELAWARE RIVER TUNNEL AND BRIDGE.
Pa Stat Ann tit 36, secs 3561, 3581 (1961), as amended, (Supp 1969).

Descriptors: *Delaware River, *Bridge construction, *Tunnel construction, *Pennsylvania, Rivers, Bridges, Construction costs, Financing, Interstate rivers, Tunnels, Delaware, Highways, Planning, Cost analysis, Project planning, State governments, Legal aspects, Legislation, Administrative agencies, Transportation, Port authorities.

The Delaware Tunnel Board is authorized to construct and operate a tunnel or tunnels under the Delaware River, connecting Pennsylvania with New Jersey, to facilitate vehicular traffic between the two states. The Delaware River Port Authority is empowered to finance, construct, acquire, and maintain a new toll bridge and such approaches thereto as are deemed necessary. The Authority is to proceed according to a plan approved by the legislatures of Pennsylvania and New Jersey. The new bridge is to be used for vehicular traffic and is to be built across the Delaware River. (Kelly-Florida)
W70-02814

FISH AND GAME.
Wis Stat Ann secs 29.135, 29.137, 29.14, 29.145 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Permits, *Fish, *Baits, Administrative agencies, Rough fish, Minnows, Shellfish, Fish handling facilities, Commercial fish, Fish harvest, Transportation, Regulation, Frogs, Crayfish, Fish hatcheries, Bait traps, Smelts, Inland waterways, Nets, Legislation, Supervisory control (Powers).
Identifiers: Bait dealers, *Fish dealers, Licensing.

Fish dealers must be licensed by the Conservation Commission. Licensees shall transport only properly labeled packaged fish. The licensee shall keep a record of all purchases of fish. Licenses from the Commission are likewise required for bait dealers. Bait is defined as any frog, crayfish, or minnow used for fishing. The Commission may regulate methods of taking, handling, and storing bait, equipment used, and may require reports from dealers. All bait dealers shall keep proper records of wholesale transactions in the production, buying, and selling of bait. The Commission shall regulate by permit the taking of bait from specified waters. These provisions do not apply to bait produced in licensed private fish hatcheries. Criminal sanctions are provided for violations of the provisions. With limited exceptions, a fishing license is required to fish in inland waters. (Dearing-Florida)
W70-02815

CONSERVATION ACT.
For primary bibliographic entry see Field 03D.
W70-02816

POWER OF BOARD OF COMMISSIONERS OF NAVIGATION TO LICENSE PILOTS.

Pa Stat Ann tit 55, secs 31, 41 thru 44 (1964)

Descriptors: *Pennsylvania, *River regulation, *Permits, *Navigable rivers, Legislation, State governments, Administration, Harbors, Inland waterways, Navigation, Boating regulations, Inspection, Boats, Transportation.
Identifiers: Pilots, Examinations, Qualifications, Licenses.

The Commissioner of Navigation has authority to grant licenses to persons to act as pilots on the Delaware River and to make and publish rules governing pilots and penalties for their breach. They decide differences arising between owners, pilots, and consignees of ships. Such decisions are reviewable by the court of common pleas. All current pilots are entitled to receive a license and subsequent renewals. No new pilots' licenses will be distributed until the class of current pilots is reduced. Those wishing to be a pilot must apply to the Commission, who will judge their qualifications on examination by a first class pilot. Classification of pilots will be determined by capability of piloting ships of different drafts. Licenses are valid for one year. Piloting a ship over seventy-five tons without a valid license is a misdemeanor. The fee for licensing is fifty cents. The qualifications for a pilot's license are listed. (Barnett-Florida)
W70-02817

RIGHT TO RUN TUNNEL UNDER RIVER TO COAL MINE.

Pa Stat Ann tit 52, sec 2 (1966).

Descriptors: *Pennsylvania, *Coal mines, *Navigable rivers, *Tunnel construction, Legislation, Tunneling, Tunnels, Mining engineering, Mining, Excavation, Underground structures, Construction, Maintenance, Administrative agencies, Administrative decisions, Streambeds, Ownership of beds, Submerged lands.

Whenever the power or manufacturing or mining plant of any company is situated upon the bank of any navigable stream and the company has the right to mine coal from land on the adjacent bank, such company may construct, operate, and maintain tunnels under said stream. These tunnels shall serve to connect the coal lands with said power or mining plant of the company. Before any company begins the construction of any tunnel, it must make application to, and secure the approval of, the Water and Power Resources Board. Companies constructing such tunnels shall pay to the Commonwealth of Pennsylvania the fair market value for all coal mined in constructing said tunnel. (Schram-Florida)
W70-02818

MINING SAFETY ZONES.
Pa Stat Ann tit 52, sec 3101 (1966).

Descriptors: *Pennsylvania, *Mining, *Safety, *Hazards, Zoning, Legislation, Regulation, Streams, Rivers, Bodies of water, Natural streams, Artificial watercourses, Administrative decisions, High water mark, Banks, Beds, River beds, Streambeds.

A safety zone is established beneath and adjacent to every stream, river, and natural or artificial body of water that is sufficiently large to constitute a hazard to mining in the opinion and in the discretion of the Department of Mines and Mineral Industries. Such safety zone shall extend horizontally two hundred feet from either the high water mark or known perimeter of the body of water. In any case, the zone shall extend downward to the limit of the workable beds. (Schram-Florida)
W70-02819

COUNTY'S RIGHT OF ENTRY FOR CONSTRUCTION.
Pa Stat Ann tit 16, secs 5905-5907, 5912 (1956).

Descriptors: *Pennsylvania, *Construction, *Bridges, Legislation, Maintenance, Culverts, Boundaries, Transportation, Roads, Storm drains, Channels, Ditches, Local governments, Damages, Alteration of flow, Obstruction to flow, Supervisory control (Power), Structures.

In the construction or maintenance of any county road or highway, the county is authorized to enter upon any private property except a railroad company's right-of-way. Such entrance is allowed for maintenance or construction of storm water drains, ditches, channels, and the inlets thereto. The county must pay any damages incurred by the owner of the land entered upon. Impairing or damaging any drain, channel, or ditch within the county by stopping or diverting the course of it shall be punishable by fine upon conviction before a magistrate. Roads forming or intended to form a continuous highway from one county to another and which cross a river, creek, or rivulet that forms the boundary line of those counties may be laid out, altered or vacated in the manner provided for other roads, except that such alteration is subject to judicial control. (Barnett-Florida)
W70-02825

FLOATING LUMBER ON THE DELAWARE RIVER.
Pa Stat Ann tit 32, secs 481, 485-487 (1967).

Descriptors: *Pennsylvania, *Lumber, *Delaware River, *Lumbering, Legal aspects, Barriers, Obstruction to flow, Structures, Concrete structures, Dams, Walls, Diversion structures, Piers, Damages, Riparian rights, Tidal waters, Legislation.
Identifiers: Drifting lumber, Rafts.

All prersons taking possession and safely securing lumber found adrift in the Delaware River shall be entitled to compensation from the owner of such lumber at set rates. Where lost lumber shall lodge upon the shore of the Delaware River, the owner of such shore shall advertise the lumber according to law and if the owner of such lumber does not appear, the owner of such shore may appropriate such lumber to his own use. Upon appearing, the owner of such lumber shall compensate the owner of the shore at set rates. When any lumber in raft is injured in consequence of piers, dams, wings, walls, or other obstructions in the Delaware River, an impartial umpire shall assess the damages and make an award. This shall not apply to loose rafts or rafts in the tidewaters. (Smith-Florida)
W70-02826

TRANSFER OF POWERS.

Pa Stat Ann tit 32, secs 815.102-815.106 (1967).

Descriptors: *Pennsylvania, *Interstate commissions, *Delaware River Basin Commission, State governments, Water resources development, Interstate rivers, *Administrative agencies, Interstate compacts, Delaware River, Delaware, Financing, Government finance, Legislation, Legal aspects, Water conservation supervisory control (Powers).

The functions and powers of the Interstate Commission on the Delaware River are hereby transferred to the Delaware River Basin Commission. All funds and properties which may be in the possession of the state and which are being held for the former body are to be transferred to the Delaware River Basin Commission. The dissolution of the Interstate Commission on the Delaware River and the transfer of its properties shall not be construed as a disavowal of any current activity or program of that body. (Kelly-Florida)
W70-02830

ARTIFICIAL PROPAGATION LICENSES AND SEINE LICENSES.
Pa Stat Ann tit 30, secs 160-165, 170-177, 179-181 (Supp 1969).

Descriptors: *Pennsylvania, *Nets, *Permits, *Fish hatcheries, Fish, Fisheries, Fish farming, Fish handling facilities, Fish management, Fish conservation, Legal aspects, Legislation, State governments, Federal government, Farm ponds, Fish establishment, Administrative agencies, Fishing gear, Carp, Herrings, Tidal waters, Fish eggs, Fry, Fish stocking, Baits.

The Pennsylvania Fish Commission is authorized to: (1) issue seine licenses; (2) regulate the kinds and mesh size of seines which may be used; (3) govern the content, expiration, and production of such licenses; (4) limit seine use to tidal waters, specific kinds of fish, and designated seasons; and (5) require the consent of the seine owner for removal of fish from seines. Fish artificially propagated are not subject to the seine license provisions. The Pennsylvania Fish Commission is authorized to: (1) issue artificial propagation licenses; (2) regulate the issuance of live bait licenses; (3) limit the authority under propagation license; (4) restrict the waters usable for commercial propagation and prohibit devices interfering with fish migration; (5) regulate the sale of fish, bait fish, and fish bait; (6) provide for the inspection of the books and property of license holders; (7) prohibit stocking with fish or eggs from Commonwealth waters; (8) make specific acts related to propagation unlawful; and (9) accord the federal government the right to establish fish-cultural stations in Pennsylvania. (Marsee-Florida)
W70-02831

WILDLIFE CONSERVATION.
Wis Stat Ann secs 29.148, 29.16, 29.174 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Wildlife conservation, *Regulation, *Permits, Legislation, Legal aspects, Administrative agencies, Michigan, Minnesota, Iowa, Fishing, Clams, Interstate compacts, Inland waterways, Recreation, Fish conservation, Wildlife management.
Identifiers: *Sturgeons.

A valid license is required for taking sturgeon by spear. So long as the states of Michigan, Minnesota, or Iowa confer upon the licensees of Wisconsin reciprocal rights, fishing and clamming licenses issued by those states will be recognized by Wisconsin in boundary waters. Seasons, bag limits, and size limits for the taking of game and fish are to be established and maintained. It is the responsibility of the State Conservation Commission to establish such regulations so as to conserve the wildlife supply and insure the citizens of the state continued opportunities for good fishing, hunting, and trapping. The method by which the Commission is to establish regulations governing the foregoing matters is provided. The Commission is directed to perform such acts as are necessary to conduct and establish a wildlife restoration project in compliance with certain acts of Congress. (Keith-Florida)
W70-02835

FISH AND GAME.

Wis Stat Ann secs 29.38, 29.39, 29.43, 29.44, 29.47, 29.475, 29.48 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Wildlife, *Permits, *Fish conservation, Administrative agencies, Regulation, Transportation, Personnel, Inland waterways, Indian reservations, Interstate, Commercial fishing, Wildlife management, Clams, Mussels, Legal aspects, Seasonal, State governments, Legislation.

It is unlawful to catch or kill mussels or clams during the close season or to have possession of any game or game fish other than in the open season. Transportation of game and fish other than in the open season is forbidden. No game may be transported in trunks or valises on any common carrier. All shipments of game must be clearly labeled. No game may be transported interstate or received interstate in violation of the laws of other states where such game was taken unless taken under license duly issued by that state. Transportation of fish from inland waters is strictly regulated with regard to amount, type, and weight. Separate restrictions are placed on fish from outlying waters. The sale of game and fish is unlawful during the close season whether taken lawfully within or without the state. Fish taken from outlying waters are subject to the commercial fishing regulations. (Barnett-Florida)
W70-02837

BRIDGES MADE SAFE.
Wis Stat Ann sec 195.31 (1957).

Descriptors: *Wisconsin, *Bridges, *Safety, *Railroads, Legislation, Legal aspects, Administrative agencies, Streams, Bridge construction, Maintenance, Repairing, Costs, Cost allocation, Damages, Cities.

When specified parties file a complaint with the Public Service Commission to the effect that a railway bridge over a stream is unsafe, the Commission will hold a hearing. If it is found that the railway bridge is unsafe, the Commission will determine what type of alteration, repair, or reconstruction is necessary to insure safety. The Commission will then apportion costs, damages, and expenses among the railroad company and other parties in interest. (Keith-Florida)
W70-02839

RIVERS; LAKES; NAVIGABLE WATERS; STATE JURISDICTION.
Wis Const Art IX sec 1 (1848).

Descriptors: *Wisconsin, *Jurisdiction, *Navigable waters, *Transportation, Legislation, Legal aspects, Rivers, Lakes, Boundaries (Property), Mississippi River, St. Lawrence River, United States, Taxes, Tariff.

Wisconsin will have concurrent jurisdiction on all rivers and lakes which form a boundary common to Wisconsin and another state. The Mississippi River and the navigable waters leading into the Mississippi and St. Lawrence rivers will be common highways and forever free to all citizens of the United States to use without charge. (Keith-Florida)
W70-02840

JURISDICTION OF COUNTIES ON BOUNDARY WATERS.
Wis Stat Ann secs 2.03, 2.04 (1967).

Descriptors: *Wisconsin, *Jurisdiction, *Boundaries (Property), *Streams, Legislation, Legal aspects, Rivers, Lake Michigan, Lake Superior, Mississippi River, Piers, Docks, Channels, Local governments.
Identifiers: Inland waters.

When two counties are separated by a river or stream, the middle of the main channel of such river or stream will be the division line between them. Counties so separated will have common jurisdiction of all offenses committed on the waters between them. The jurisdiction of counties on specified boundary lakes and state boundary waters is fixed by giving joint jurisdiction to the counties on a directional side of the body of water in question. When two or more counties bound any inland water of the state, they will have jurisdiction in common of all offenses committed on any part of such inland water. (Keith-Florida)
W70-02841

POWERS OF THE DEPARTMENT OF RESOURCE DEVELOPMENT.
For primary bibliographic entry see Field 04A.
W70-02842

6G. Ecologic Impact of Water Development

SOME ASPECTS OF THE EFFECTS OF THE QUANTITY AND QUALITY OF WATER ON BIOLOGICAL COMMUNITIES IN EVERGLADES NATIONAL PARK,
Geological Survey, Miami, Fla. Water Resources Div.
For primary bibliographic entry see Field 04C.
W70-02631

A PRELIMINARY ECOLOGICAL SURVEY OF THE WATER RESOURCES AND LAND USE PATTERNS OF THE DISMAL SWAMP AREA OF VIRGINIA,
Virginia Polytechnic Inst., Blacksburg.
C. Duke Wilder, Jr., Paul M. Brady, George M. Simmons, Stuart E. Neff, and L. A. Hart.
Project Completion Report, Virginia Water Resource Research Center, 1969. 4 p. OWRR Project A-020-VA.

Descriptors. *Aquatic habitats, *Ecology, *Fish populations, Limnology, Primary productivity, Vegetation, Water resources, Wetlands, Temperature, Acidity, Salinity, Oxygenlevels.
Identifiers: *Dismal Swamp, *Lake Drummond.

A detailed analysis of the fish populations was made and some suggestions were made concerning fish management in Lake Drummond. Information was acquired on temperature, oxygen levels, acidity, salinity, and primary productivity. Aerial photography of a selected portion of Dismal Swamp was flown using several film and filter techniques. It was concluded that the most important single need for an understanding of the environment of Dismal Swamp is a one- or two-year detailed limnological study. There is an indication from this study that the basic physical and chemical conditions of the water are not conductive to a high, balanced, biological productivity, but this aspect required much more detailed study.
W70-02746

ECOLOGY OF SELECTED AQUATIC BACTERIA IN THE SNAKE RIVER,
Washington State Univ., Pullman.
For primary bibliographic entry see Field 05C.
W70-02763

07. RESOURCES DATA

7A. Network Design

DATA ERROR EFFECTS IN UNIT HYDROGRAPH DERIVATION,
New South Wales Univ., Sydney (Australia). Dept. of Civil Engineering; and Imperial Coll. of Science and Technology, London (England).
Eric M. Laurenson, and Terence O'Donnell.
ASCE Proc, J Hydraul Div, Vol 95, No HY6, Pap 6887, p 1899-1917, Nov 1969. 19 p, 7 fig, 6 tab, 10 ref, append.

Descriptors: *Hydrograph analysis, *Unit hydrographs, *Rainfall-runoff relationships, *Flood forecasting, Streamflow forecasting, Sampling, Rain gages, Discharge (Water), Hyetographs, Hydrographs, Hydraulics, Hydrology, Data processing.
Identifiers: Hydrograph synthesis.

Errors in rainfall and streamflow data cause errors in derived unit hydrographs. The effects of various types of data error on unit hydrographs derived by various methods have been examined. The data errors studied were those in the loss-rate assumption, total rainfall measurement, the discharge rating curve, base-flow separation, and time synchronization of rain gages and streamflow recorder. The methods of derivation were the harmonic, Laguerre, least squares, and gamma distribution methods. Effects of hyetograph and unit hydrograph shapes were also investigated. It was concluded that unit hydrograph shape had little effect, and that hyetograph shape had little effect except in combination with the Laguerre method, when it was of critical importance. No single method of derivation could be recommended in preference to the others. Synchronization-type data errors and the uniform loss-rate assumption tend to produce significant errors in the unit hydrograph, but the other error types caused surprisingly low errors. (Knapp-USGS)
W70-02454

GENERALIZED ANALYSIS OF SMALL WATERSHED RESPONSES,
California Univ., Davis.
For primary bibliographic entry see Field 02A.
W70-02763

7B. Data Acquisition

TRIANGULAR BROAD-CRESTED WEIR,
Saskatchewan Univ., Saskatoon. Dept. of Civil Engineering; and Colorado State Univ., Fort Collins.
Clifford D. Smith, and Wen S. Liang.
ASCE Proc, J Irrig and Drainage Div, Vol 95, No IR4, Pap 6954, p 493-502, Dec 1969. 10 p, 9 fig, 1 tab, 4 ref, append.

Descriptors: *Stage-discharge relations, *Weirs, *Water measurement, Critical flow, Flow measurement, Discharge (Water), Open channel flow, Hydraulics, Discharge measurement, Gaging stations, Gages.
Identifiers: Broad-crested weirs.

The advantages of flow measurement with a thin plate V-notch weir and a broad-crested weir are reviewed briefly. The triangular broad-crested weir is intended to combine the advantages of both in a single structure. The discharge coefficient and limiting submergence are derived from simple theory based on the assumption of critical flow. Details are given for experiments carried out on a weir with a 90 deg notch angle and four different lengths of broad crest. It was found that the actual coefficient was less than theoretical and was not constant; however, the limiting submergence agreed exactly with theory, provided the length of the broad crest was at least three times the head. A design curve for the coefficient is included.
W70-02449

FRICTION FACTORS FOR FLOW IN SAND-BED CHANNELS,
Massachusetts Inst of Tech., Cambridge. Hydrodynamics Lab.; and Iowa Univ., Iowa City. Inst of Hydraulic Research
For primary bibliographic entry see Field 02J.
W70-02461

ENUMERATION OF AUTOTROPHIC AMMONIUM-OXIDIZING BACTERIA IN MARINE WATERS BY A DIRECT METHOD,
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Environmental Sciences.
M. S. Finstein.
Applied Microbiology, Vol 16, No 11, p 1646-1649, Nov 1968. 3 fig, 2 tab, 10 ref.

Descriptors: *Marine microorganisms, *Nitrification, *Bacteria, *Methodology, Nitrites, Eutrophication, Analytical techniques, Ammonium salts, Nitrogen cycle, Cycling nutrients, Water pollution effects.
Identifiers: *Autotrophic microorganisms, *Bacteria counting, *Techniques, Most-probable-number technique, Enumeration techniques.

A new method is presented for enumerating those autotrophic nitrifying bacterial colonies capable of oxidizing ammonia to nitrite, and compared with the MPN (most-probable-number) technique. In this method, membrane filtration is followed by 18-25 days incubation of the filter on the surface of glass wool pads saturated with ammonium-rich nutrients. Membranes are then freed of nitrite and incubated on the surface of ammonium-containing agar for 5-30 minutes. Application of standard reagents for nitrite develops colored spots on the agar, coinciding with nitrifying colonies on the membrane, which colonies are dependent on the presence of ammonium in the agar. Membranes with single nitrifying regions caused vigorous nitrification when transferred to mineral salts medium, while membranes without nitrifying regions did not. Author concludes that filter technique is adequately sensitive and more precise than MPN. Results from replicate membrane samples fell within confidence limits of those from replicate MPN samples. Confidence limits of estimates from replicate membrane tests were narrower than those from MPN tests. Only seawater samples were tested, but the technique may be adaptable to fresh waters. Author evaluates advantages and disadvantages for the two methods, and presents a technique for increasing filtration speed. (Gerhold-Wisconsin)
W70-02507

BASIN TRACER CURVES INTERPRETED BY BASIC ANALYTICS,
Bason and Filter Specialty Co., Shreveport, La.
A. Adler Hirsch.
ASCE Proceedings, Journal of the Sanitary Engineering Division, Vol 95, No SA6, Paper 6951, p 1031-1050, Dec 1969. 20 p, 7 fig, 2 tab, 25 ref, append.

Descriptors *Tracers, Tracking techniques, *Sediment transport, Reservoirs, Watersheds (Basins), Sedimentation, Streamflow, Dye releases, Mathematical studies, Analytical techniques.
Identifiers: Basin tracer curves.

A basin flow tracer test with pulse injection may be characterized as passage of a material shock wave. Virtual transit is related to the maximum slope on the dimensionless time versus concentration curve. The plug point, which separates plug from non-plug flow, is located at the initial arrival of tracer for straight rising or convex upward ascents, and (hypothetically) at the first tangential subinflectum of ogive ascents. Plug flow extends from the origin to the plug point, dual flow exists from the plug

point to the descending inflectum; beyond that flow is the mixed or eddied type. Short-circuiting is indicated directly by the distance between plug point and nominal detention time. The negative exponent of the semi-logarithmic plot of the decline denotes the number of times the effective fraction of basin volume is extracted by non-plug flow. Curves replotted from the literature confirm this theory. Dispersion is measured by the angle between the tangent to the plug point with the vertical. A concise diagram having plug point and dispersion as coordinates permits comparison of basins. (Knapp-USGS)
W70-02633

MEASURING SUBSURFACE SPRING FLOW WITH RADIOTRACERS,
Federal Water Pollution Control Administration, Dallas, Tex.; and Corps of Engineers, Tulsa, Okla. Engineering Div.
William C. Galegar, and Myron W. DeGeer.
ASCE Proceedings, Journal of the Sanitary Engineering Division, Vol 95, No SA6, Paper 6973, p 1097-1103, Dec 1969. 7 p, 4 fig, 2 ref.

Descriptors: *Tracers, *Tritium, *Groundwater movement, *Texas, *Springs, Streamflow, Tracking techniques, Leakage, Seepage, Water pollution sources, Brines, Saline water systems, Aquifers, Karst, Groundwater.
Identifiers: Estelline Spring (Tex).

A hydrostatic head was imposed on Estelline Spring, Texas to prevent surface discharge and subsequent natural salt pollution of the Red River. This paper describes the use of tritiated water as a tracer to determine the rate of subsurface leakage of the Spring, the size of the Spring cavern, and the location of that area where subsurface leakage returns to the surface. Other techniques using salt and organic dyes did not prove successful, due largely to insensitivity in detection and probable losses to adsorption and degradation. The volume of the known spring chimney, including that within the dike, amounts to about 389,800 cu ft. Knowing the amount of tracer added and the initial concentration of tracer after mixing, it was determined that a volume of 493,960 cu ft existed. From these data, it is concluded that a second chamber exists below that which was previously known; and its volume amounts to about 104,000 cu ft. (Knapp-USGS)
W70-02637

A FALLING-PARTICLE CURRENT METER,
Columbia Univ., Dobbs Ferry, N.Y. Hudson Labs.
T. E. Pochapsky.
Report avail from Clearinghouse as AD 679 195, $3.00 in paper copy, $0.65 in microfiche. Hudson Laboratories Technical Report No 151, Columbia University, May 1968. 22 p, 7 fig, 1 ref. Contract Nonr-266 (84) ONR.

Descriptors: *Current meters, *Instrumentation, *Ocean currents, Flow measurement, Gages, Currents (Water), Stream gages, Sea water, Velocity, Oceanography, Marine geology, Ocean circulation.
Identifiers: Falling-sphere current meter.

Small dense spheres sink in water with a predictable velocity. A horizontal current deflects the path of sinking and the magnitude of the current can be determined from the horizontal deflection. This procedure can be used to measure very small currents, particularly those below one cm/sec, which are too small to operate most current meters. A meter built to operate on this principle at sea is described. (Knapp-USGS)
W70-02670

A FLUOROMETRIC METHOD FOR DETERMINING TRACE QUANTITIES OF FLUORIDE,
Missouri Univ., Columbia. Dept. of Chemistry.
John C. Guyon, Berwyn E. Jones, and David A. Britton.
Mikrochimica Acta, Vol 6, p 1180-1184, 1968. OWRR Project A-014-MO.

Descriptors: *Analytical techniques, *Fluorescence, *Fluorides, *Ions, Chemistry, Trace elements.
Identifiers: Determination, Water samples, Anions.

A very selective method has been developed for the determination of ug quantities of fluoride based on the fluorescence quenching by fluoride of the zirconium-flavonol chelate. The fluorescence intensity is read at 460 nm. The reduction in fluorescence intensity caused by the fluoride is a measure of the fluoride concentration present.
W70-02726

A FLUOROMETRIC DETERMINATION OF IODIDE ION,
Missouri Univ., Columbia. Dept. of Chemistry.
David A. Britton, and John C. Guyon.
Microchemical Journal, Vol 14, No 1, p 1-6, Mar 1969. 2 tab, 2 fig, 2 ref. OWRR Project A-014-MO.

Descriptors: *Analytical techniques, Chemistry, *Fluorescence, *Ions, Trace elements.
Identifiers: Determination, Water samples, Anions, *Iodide ion.

A very selective, simple, sensitive fluorometric method for the determination of iodide ion was developed. The method is based on iodide quenching the fluorescence of an uranyl acetate solution. The fluorescence is measured at 520 mu. A nearly linear calibration curve is obtained for 2 to 20 ug of iodide ion.
W70-02727

FLUOROMETRIC DETERMINATION OF OXALATE ION,
Missouri Univ., Columbia. Dept. of Chemistry.
David A. Britton, and John C. Guyon.
Anal Chim Acta, Vol 44, p 397-401, 1969. 2 tab, 1 fig, 4 ref. OWRR Project A-014-MO.

Descriptors: *Analytical techniques, *Fluorescence, *Ions, Chemistry, Trace elements.
Identifiers: *Oxalate ion, Determination, Water samples, Anions.

A very selective, simple, sensitive fluorimetric method for the determination of oxalate ion is described. The method on the quenching by oxalate of the fluorescence of a 1:1 zirconium-flavonal chelate in dilute sulfuric acid solution. The fluorescence is measured at 460 nm. A linear calibration curve is obtained for 0-10 ug of oxalate ion; there are very few interferences.
W70-02728

CURRENT STUDY IN THE NEUSE RIVER AND ESTUARY OF NORTH CAROLINA,
North Carolina Univ., Morehead City. Inst of Marine Sciences.
For primary bibliographic entry see Field 02L.
W70-02760

7C. Evaluation, Processing and Publication

FORTRAN-HYDRO,
Purdue Univ., Lafayette, Ind. School of Civil Engineering.
Jacques W. Delleur, and Gerrit H. Toebes.
ASCE Proc, J Hydraul Div, Vol 95, No HY6, Pap 6901, p 1993-2012, Nov 1969. 20 p, 10 fig, 2 tab, 7 ref, 4 append.

Descriptors: *Computer programs, *Data processing, *Hydrologic data, Open channel flow, Water resources, Digital computers, Groundwater movement, Hydraulics, Hydrology.
Identifiers: FORTRAN, ALGOL.

Computer programming, and particularly problem-oriented languages, useful in solving water resources engineering problems are reviewed. The original HYDRO language started by G. Bugliarello and associates, was written in ALGOL. At present about 70 computation procedures are available, principally in hydrology, and hydraulic engineering. A FORTRAN adaptation of this language, called FORTRAN-HYDRO (FH), was developed. FH consists of a system of interlocking FORTRAN IV subroutines that may be strung or looped within a standard FORTRAN IV program. A library of 45 standard computation procedures in Hydrology and in Open Channel Hydraulics is available, and is expected to be extended. FH may be implemented on any computer having a FORTRAN compiler, an internal memory of at least 32K, and a fast access auxiliary memory. It has been found useful for teaching hydrology, hydraulics and water resources engineering. Some further work may make it of value to the practitioner as well. Methods of extending the library of subroutines as well as ways of contributing to it are suggested. (Knapp-USGS)
W70-02453

OPEN-CHANNEL SURGE SIMULATION BY DIGITAL COMPUTER,
Georgia Inst. of Tech., Atlanta. School of Engineering, and Harza Engineering Co., Chicago, Ill. Dept. of Hydraulics.
For primary bibliographic entry see Field 08B.
W70-02459

AN INVESTIGATION OF FLOODS IN HAWAII THROUGH SEPTEMBER 30, 1968,
Geological Survey, Honolulu, Hawaii.
R. Lee, and K. H. Fowler
Geol Surv Basic Data Progr Rep No 11, June 1969 170 p, 5 fig, 1 tab.

Descriptors: *Floods, *Hawaii, *Hydrologic data, *Data collections, Streamflow, Stage-discharge relations, Gaging stations, Stream gages.
Identifiers: *Flood records (Hawaii).

Records are compiled of annual peak stage and discharge at gaging stations in Hawaii through 1968. Each record consists of station name, description, location, drainage area, gage type, and maximum stage, maximum discharge, and date of maximum discharge for each water year of record. Gage locations are shown by maps. (Knapp-USGS)
W70-02471

FREQUENCY ANALYSIS OF RAINFALL INTENSITIES FOR CALCUTTA,
All-India Inst of Hygiene and Public Health, Calcutta; and Calcutta Metropolitan Planning Organization (India).
For primary bibliographic entry see Field 02B.
W70-02634

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, KREOLE-GRAND BAY SW QUADRANGLES, MISSISSIPPI-ALABAMA,
Geological Survey, Washington, D.C.
K. V. Wilson, and James W. Hudson.
Geol Surv Hydrol Invest Atlas HA-407, 1 sheet, 1969. Text, 2 fig, 1 map, 1 tab, 3 ref

Descriptors: *Floods, *Mississippi, *Hurricanes, *Flood damage, *Coasts, *Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Winds, Disasters, Storms, Waves (Water), Water levels, Water level fluctuations, Inlets (Waterways), Sea level, Shores.
Identifiers: *Hurricane Camille (1969), Kreole (Miss), Grand Bay (Ala), Tidal floods, Storm tides.

The areas flooded by Hurricane Camille tides of August 18, 1969 along the Mississippi Gulf Coast are shown in a series of hydrologic atlases. The Atlas of the Kreole and Grand Bay, SW quadrangles show flooded areas on a topographic map scaled 1:24,000. Camille was the most intense hurricane on record to enter the U.S. mainland. Estimated maximum winds were 190 mph, and the central pressure was 26.61 inches of mercury. The eye

of the storm, traveling about due north, passed over the Waveland,Bay St. Louis area and winds of over 75 mph extended about 50 mi on each side. Maximum precipitation was 10 inches. Flooding was most severe in the Pass Christian area where tides reached 26 ft above msl. High tide frequency and annual maximum tide are shown by graphs. (K-napp-USGS)
W70-02660

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, BAY ST. LOUIS QUADRANGLE, MISSISSIPPI,
Geological Survey, Washington, D.C.
K. V. Wilson, and James W. Hudson.
Geol Surv Hydrol Invest Atlas HA-400, 1 sheet, 1969. Text, 2 fig, 1 photo, 1 map, 1 tab, 3 ref.

Descriptors: *Floods, *Mississippi, *Hurricanes, *Flood damage, *Coasts, *Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Winds, Disasters, Storms, Waves (Water), Water levels, Water level fluctuations, Inlets (Waterways), Sea level, Shores.
Identifiers: *Hurricane Camille (1969), Bay St. Louis (Miss), Tidal floods, Storm tides.

The areas flooded by Hurricane Camille tides of August 18, 1969 along the Mississippi Gulf Coast are shown in a series of hydrologic atlases. The Atlas of the Bay St. Louis quadrangle shows flooded areas on a topographic map scaled 1:24,000. Camille was the most intense hurricane on record to enter the U.S. mainland. Estimated maximum winds were 190 mph, and the central pressure was 26.61 inches of mercury. The eye of the storm, traveling about due north, passed over the Waveland-Bay St. Louis area and winds of over 75 mph extended about 50 mi on each side. Maximum precipitation was 10 inches. Flooding was most severe in the Pass Christian area where tides reached 25 ft above msl. High tide frequency and annual maximum tide are shown by graphs. (K-napp-USGS)
W70-02661

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, GULFPORT NW QUADRANGLE, MISSISSIPPI,
Geological Survey, Washington, D.C.
K. V. Wilson, and James W. Hudson.
Geol Surv Hydrol Invest Atlas HA-401, 1 sheet, 1969. Text, 2 fig, 1 map, 1 tab, 3 ref.

Descriptors: *Floods, *Mississippi, *Hurricanes, *Flood damage, *Coasts, *Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Winds, Disasters, Storms, Waves (Water), Water levels, Water level fluctuations, Inlets (Waterways), Sea level, Shores.
Identifiers: *Hurricane Camille (1969), Gulfport (Miss), Tidal floods, Storm tides.

The area flooded by Hurricane Camille tides of August 18, 1969 along the Mississippi Gulf Coast are shown in a series of hydrologic atlases. The Atlas of the Gulfport NW quadrangle shows flooded areas on a topographic map scaled 1:24,000. Camille was the most intense hurricane on record to enter the U.S. mainland. Estimated maximum winds were 190 mph, and the central pressure was 26.61 inches of mercury. The eye of the storm, traveling about due north, passed over the Waveland-Bay St. Louis area and winds of over 75 mph extended about 50 mi on each side. Maximum precipitation was 10 inches. Flooding was most severe in the Pass Christian area where tides reached 25 ft above msl. High tide frequency and annual maximum tide are shown by graphs. (Knapp-USGS)
W70-02662

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, PASS CHRISTIAN QUADRANGLE, MISSISSIPPI,
Geological Survey, Washington, D.C.
K. V. Wilson, and James W. Hudson.
Geol Surv Hydrol Invest Atlas HA-402, 1 sheet, 1969. Text, 2 fig, 1 photo, 1 map, 1 tab, 3 ref.

Descriptors: *Floods, *Mississippi, *Hurricanes, *Flood damage, *Coasts, Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Winds, Disasters, Storms, Waves (Water), Water levels, Water level fluctuations, Inlets (Waterways), Sea level, Shores.
Identifiers: *Hurricane Camille (1969), Pass Christian (Miss), Tidal floods, Storm tides.

The areas flooded by Hurricane Camille tides of August 18, 1969 along the Mississippi Gulf Coast are shown in a series of hydrologic atlases. The Atlas of the Pass Christian quadrangle shows flooded areas on a topographic map scaled 1:24,000. Camille was the most intense hurricane on record to enter the U.S. mainland. Estimated maximum winds were 190 mph, and the central pressure was 26.61 inches of mercury. The eye of the storm, traveling about due north, passed over the Waveland-Bay St. Louis area and winds of over 75 mph extended about 50 mi on each side. Maximum precipitation was 10 inches. Flooding was most severe in the Pass Christian area where tides reached 25 ft above msl. High tide frequency and annual maximum tide are shown by graphs. (K-napp-USGS)
W70-02663

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, GULFPORT NORTH-SOUTH QUADRANGLES, MISSISSIPPI,
Geological Survey, Washington, D.C.
K. V. Wilson, and James W. Hudson.
Geol Surv Hydrol Invest Atlas HA-403, 1 sheet, 1969. Text, 2 fig, 2 photo, 1 map, 1 tab, 3 ref.

Descriptors: *Floods, *Mississippi, *Hurricanes, *Flood damage, *Coasts, Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Winds, Disasters, Storms, Waves (Water), Water levels, Water level fluctuations, Inlets (Waterways), Sea level, Shores.
Identifiers: *Hurricane Camille (1969), Gulfport (Miss), Tidal floods, Storm tides.

The areas flooded by Hurricane Camille tides of August 18, 1969 along the Mississippi Gulf Coast are shown in a series of hydrologic atlases. The Atlas of the Gulfport N and S quadrangles show flooded areas on a topographic map scaled 1:24,000. Camille was the most intense hurricane on record to enter the U.S. mainland. Estimated maximum winds were 190 mph, and the central pressure was 26.61 inches of mercury. The eye of the storm, traveling about due north, passed over the Waveland-Bay St. Louis area and winds of over 75 mph extended about 50 mi on each side. Maximum precipitation was 10 inches. Flooding was most severe in the Pass Christian area where tides reached 25 ft above msl. High tide frequency and annual maximum tide are shown by graphs. (K-napp-USGS)
W70-02664

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, VIDALIA QUADRANGLE, MISSISSIPPI,
Geological Survey, Washington, D.C.
K. V. Wilson, and James W. Hudson.
Geol Surv Hydrol Invest Atlas HA-399, 1 sheet, 1969. Text, 2 fig, 1 map, 1 tab, 3 ref.

Descriptors: *Floods, *Mississippi, *Hurricanes, *Flood damage, *Coasts, *Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Winds, Disasters, Storms, Waves (Water), Water levels, Water level fluctuations, Inlets (Waterways), Sea level, Shores.
Identifiers: *Hurricane Camille (1969), Vidalia (Miss), Tidal floods, Storm tides.

The areas flooded by Hurricane Camille tides of August 18, 1969 along the Mississippi Gulf Coast are shown in a series of hydrologic atlases. The Atlas of the Vidalia quadrangle shows flooded areas on a topographic map scaled 1:24,000. Camille was the most intense hurricane on record to enter the U.S. mainland. Estimated maximum winds were 190 mph, and the central pressure was 26.61 inches of mercury. The eye of the storm, traveling about due north, passed over the Waveland-Bay St. Louis area and winds of over 75 mph extended about 50 mi on each side. Maximum precipitation was 10 inches. Flooding was most severe in the Pass Christian area where tides reached 25 ft above msl. High tide frequency and annual maximum tide are shown by graphs. (K-napp-USGS)
W70-02665

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, WAVELAND-GRAND ISLAND PASS QUADRANGLES, MISSISSIPPI,
Geological Survey, Washington, D.C.
K. V. Wilson, and James W. Hudson.
Geol Surv Hydrol Invest Atlas HA-398, 1 sheet, 1969. Text, 2 fig, 1 map, 1 tab, 3 ref.

Descriptors: *Floods, *Mississippi, *Hurricanes, *Flood damage, *Coasts, *Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Winds, Disasters, Storms, Waves (Water), Water levels, Water level fluctuations, Inlets (Waterways), Sea level, Shores.
Identifiers: *Hurricane Camille (1969), Waveland (Miss), Grand Island Pass (Miss), Tidal floods, Storm tides.

The areas flooded by Hurricane Camille tides of August 18, 1969 along the Mississippi Gulf Coast are shown in a series of hydrologic atlases. The Atlas of the Waveland and Grand Island Pass quadrangles show flooded areas of a topographic map scaled 1:24,000. Camille was the most intense hurricane on record to enter the U.S. mainland. Estimated maximum winds were 190 mph, and the central pressure was 26.61 inches of mercury. The eye of the storm, traveling about due north, passed over the Waveland-Bay St. Louis area and winds of over 75 mph extended about 50 mi on each side. Maximum precipitation was 10 inches. Flooding was most severe in the Pass Christian area where tides reached 25 ft above msl. High tide frequency and annual maximum tide are shown by graphs. (K-napp-USGS)
W70-02666

BEDLOAD FORMULAS,
Pennsylvania State Univ., University Park. Coll. of Engineering.
For primary bibliographic entry see Field 02J
W70-02671

STOCHASTIC BASIS FOR COMPREHENSIVE RIVER BASIN PLANNING: PHASE I,
Union Coll., Schenectady, N.Y. Water Resources Research Group.
For primary bibliographic entry see Field 06A.
W70-02681

08. ENGINEERING WORKS

8A. Structures

CONSTRUCTION OF THE KRASNOYARSK RESERVOIR AND ITS SHORE DEVELOPMENT (RUSSIAN),
V. M. Shirokov.
In: Vodnye Resursy i Vodnoe Khozyaystvo Sibiri (Water Resources and Water Economy of Siberia). Akad Nauk SSSR, Sibirskoye Otdeleniе, Geogr Obshchestvo, Novosibirsk, USSR, p 9-16, 1968. 8 p, 1 fig, 1 tab, 5 ref.

Descriptors: Water resources development, *Reservoir construction, Reservoir operation,

*Bank stability, Shores, Water storage, Topography, Talus, Sediments, Floods, Frequency, Water levels.
Identifiers: *USSR, Krasnoyarsk Reservoir.

The dimensions and capacity of the proposed Krasnoyarsk reservoir of the Yorisei River are described and some forecasting pertaining to the development of its shoreline is given. The basic characteristics of this reservoir are as follows: the volume is 30 cubic kilometers, the area is 2100 square kilometers, the normal reservoir level is 243.0 m, and the level of 0.01% frequency flood is 244.2 m. It is believed that the presence of various types of rock outcrops in the reservoir areas and their topographical variations will considerably interfere with the formation of new shore slopes and shorelines. (Gabriel-USGS)
W70-02480

THE MAJARDAH SCHEME,
Long Island Univ., Greenvale, N.Y. C. W. Post Coll.
For primary bibliographic entry see Field 03F.
W70-02560

VIGILANCE OVER RESERVOIRS,
Gruner Brothers, Basle (Switzerland).
For primary bibliographic entry see Field 06E.
W70-02639

REVETMENTS FOR BANK PROTECTION USING VERY ROUGH-SURFACED FERRO-CONCRETE ELEMENTS (FRENCH),
Institut d'Amenagement et d'Economie de l'Eau, Warsaw (Poland).
M. M. Zajbert.
Perma Int Asso of Navigation Congr, XXIInd Int Navigation Congr, Sect 1, Subj 6, Inland Navigation, p 139-156, Paris, 1969. 18 p, 15 fig.

Descriptors: *Retaining walls, *Construction, *Slabs, Navigable waters, Water pressure.

Pre-fabricated reinforced concrete slabs with parallel ribs have been developed to reduce wave height. The influence of the height, spacing and form of the ribs has been determined. The reduction in wave breaking height increases rapidly with the height of the ribs. The ribbed slab permits an economy in the use of concrete. Empirical formulae determine the dimensions at which the slab will be sufficiently resistant to pressure. The principal applications of this process in Poland are described. The article is written in French and includes an English summary. (Grossman-Rutgers)
W70-02696

SHORE EROSION AND PROTECTION ST. LAWRENCE RIVER-CANADA,
Department of Public Works (Canada).
C. K. Hurst, and Dr. A. Brebner.
Perma Int Asso of Navigation Congr, XXIInd Int Navigation Congr, Sect 1, Sub 6, Inland Navigation, p 45-56, Paris, 1969. 12 p, 16 fig, 1 tab.

Descriptors: *Bank erosion, Costs, Federal government, Local government, Navigation.
Identifiers: *Saint-Lawrence River.

With the increase in ocean traffic on the St. Lawrence and the parallel increase of industries and population along its banks, the problem of bank protection has become important. The costs of protecting the banks are borne by the governments. The Federal government bears the costs of erosion of the banks due to shipping; the local authorities pay the costs that result from natural erosion, effects of the current, and waves caused by wind or ice. The main cause of bank erosion is the passage of shipping. Measurements along the river indicate that the height of the waves and the lowering of the water level caused by shipping depend upon the velocity of the ships and the width of the channels. For rivers having a width under 2,000 feet, navigation is the main cause of bank erosion. For widths over 4,000 feet the effect of navigation on the banks is negligible. Arrangements on the distribution of expenditure have been made. The article is written in English and contains a French summary. (Grossman-Rutgers)
W70-02697

HISTORICAL, FIELD AND EXPERIMENTAL STUDIES OF THE SUEZ CANAL BANK PROTECTION,
Suez Canal Authority Research Center, Ismailia (Egypt); and International Commission for Irrigation and Drainage.
Dr. Eng. A. A. Ammar.
Perma Int Asso of Navigation Congr, XXIInd Int Navigation Congr, Sect 1, Subj 6, Inland Navigation, p 199-213, Paris, 1969. 15 p, 10 fig, 2 tab, 7 ref.

Descriptors: *Retaining walls, *Costs, Grading, Bank stability, Asphalt.
Identifiers: *Traffic capacity, Synthetic fabrics.

The objective is to protect at the lowest cost the banks of the canal against erosion caused by the return current and by the waves made by shipping. The paper describes the evolution of measures taken over the years to cope with increasing traffic. Tests have been carried out on the use of new materials: asphalt and synthetic fabrics. The choice of the type of revetment to be used should spring from a technical and economic study which takes into account the construction, maintenance and working costs of the navigable waterway, and also the working costs of the vessels using the waterway. The article is written in English and includes a French summary. (Grossman-Rutgers)
W70-02698

METHODS OF BANK PROTECTION FOR PORT, INLAND WATER-WAY AND RIVER,
Toa Harbour Works Co. Ltd., Tokyo (Japan). Engineering Dept.
Akira Katayama.
Perm Asso of Navigation Congr, XXIInd Int Navigation Congr, Sect 1, Subj 6, Inland Navigation, p 87-108, Paris, 1969. 2 p, 17 fig, 5 photo, 3 tab.

Descriptors: *Retaining walls, Navigable waters, Costs, Construction materials.
Identifiers: *Flexible mattress.

A recently developed method to avoid undermining of coastal or river bank structures is explained. This method consists in covering the foundation with a mattress made up of a series of synthetic material sacks filled with sand. This mattress is flexible and it adapts itself to foundation soil movements. The choice of synthetic material used must resist friction and ultra-violet rays. Several examples of the use of this method are given. The main features of this method are its rapidity of construction and low cost. The article is written in English and includes a French summary. (Grossman-Rutgers)
W70-02699

A STUDY OF FLOW CONDITIONS IN SHAFT SPILLWAYS,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
Yusuf G. Mussalli, and M. R. Carstens.
Available from the Clearinghouse as PB-188 909, $3.00 in paper copy, $0.65 in microfiche. Water Resources Center, Georgia Institute of Technology, Report WRC-0669, Sept 1969. 158 p, 4 tab, 68 fig, 56 ref. OWRR Project B-022-GA.

Descriptors: *Spillways, *Vertical conduits, *Horizontal conduits, *Closed-conduit flow, *Closed conduits, *Flow control, *Weirs, Aeration, Air demand, Critical flow, Outlets, Turbulent flow, Aerated flow, Air entrainment, Weir control.
Identifiers: *Vertical shaft spillways, *Inclined-shaft spillways.

The purpose of the study was to develop data for design of vertical-and inclined-shaft spillways. A vertical shaft 4 inches square connected to a horizontal conduit by a 90-degree circular bend was used in the experiments. Studies were conducted using bend configurations of 3 different radii and various deflectors and with varying amounts of air admitted to the vertical shaft. The research demonstrates clearly the role of the bend curvature, deflector and air concentration on the phenomenon of sealing or transition to pipe control in the horizontal conduit. Sealing of the horizontal conduit depends on the Froude number of the flow. To maintain partly-full flow in the horizontal conduit, more air space is needed above the water flow area with an increase in Froude number. The water-flow area in the horizontal conduit with short-tube control is determined by the ratio of the radius of curvature along the centerline to the bend diameter and the deflector thickness at the crown. Ventilation of the horizontal conduit delays sealing and aeration of the water flow hastens sealing. With weir control, waves on the flow surface hasten sealing and highly aerated flow delays sealing. Ratios of radius of curvature along the centerline to the bend diameter larger than 2.0 are recommended, as bends of larger ratios generate less waves. (Conway-Georgia Tech)
W70-02774

COUNTY'S RIGHT OF ENTRY FOR CONSTRUCTION.
For primary bibliographic entry see Field 06E.
W70-02825

8B. Hydraulics

TRIANGULAR BROAD-CRESTED WEIR,
Saskatchewan Univ., Saskatoon. Dept. of Civil Engineering; and Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 07B.
W70-02449

EFFECT OF INTAKE ELEVATION AND OPERATION ON WATER TEMPERATURE,
Tennessee Valley Authority, Norris.
Walter O. Wunderlich, and Rex A. Elder
ASCE Proc, J Hydraul Div, Vol 95, No HY6, Pap 6917, p 2081-2091, Nov 1969. 11 p, 9 fig, 11 ref.

Descriptors: *Water temperature, *Reservoir operation, Stratification, Water resources development, Planning, Reservoir design, Water management (Applied), Water quality, Water quality control, Flood control, Simulation analysis, Thermodynamics.
Identifiers: Water temperature control, Reservoir thermodynamics.

A graphical temperature prediction method based on simplifying assumptions is used to demonstrate how intake elevation and operation at certain times of the year influence outflow water temperature during a yearly cycle of temperature stratification buildup and decay. Temperature predictions are made for 3 different intake elevations and 3 different years in which the hydrologic conditions require different reservoir operations. The method illustrates how intake elevation, reservoir operation and geometry, surface or bottom intake operation, inflow quantity and its annual distribution, inflow temperature, water surface elevation and climate influence outflow temperature. Additional applications are made to an existing reservoir to simulate a known operation and to check the reliability of the method. For the same reservoir, the outflow temperature of an assumed drastic operation change is predicted. The results show that dependent upon the combination of all factors, one and the same reservoir can produce a great variety of temperature patterns. (Knapp-USGS)
W70-02456

FLUCTUATING PRESSURES IN SPILLWAY STILLING BASINS,
Minnesota Univ., Minneapolis. Dept. of Civil Engineering; and Iowa State Univ., Ames. Dept of Engineering Mechanics.
C. Edward Bowers, and Frank Y. Tsai.
ASCE Proc, J Hydraul Div, Vol 95, No HY6, Pap 6915, p 2071-2079, Nov 1969. 9 p, 9 fig, 6 ref.

Descriptors: *Stilling basins, *Unsteady flow, *Hydraulic models, *Hydraulic jump, Turbulence, Vortices, Open channel flow, Spillways, Energy dissipation, Flow, Surges, Laboratory tests, Model studies.
Identifiers: *Stilling-basi n pressure fluctuations.

Experimental data are presented on fluctuating pressures in models of spillway stilling basins. Of special interest are data on (1) variation of pressure fluctuations with location in the basin, (2) variation of fluctuations with discharge, and (3) the growth of a pressure pulse as flow passes through the upstream portion of the hydraulic jump. Pressure fluctuations up to plus or minus 40% of the incident-velocity head were measured during the tests. (Knapp-USGS)
W70-02457

OPEN-CHANNEL SURGE SIMULATION BY DIGITAL COMPUTER,
Georgia Inst. of Tech., Atlanta. School of Engineering, and Harza Engineering Co., Chicago, Ill. Dept. of Hydraulics.
C. Samuel Martin, and Frank G. DeFazio.
ASCE Proc, J Hydraul Div, Vol 95, No HY6, Pap 6911, p 2049-2070, Nov 1969. 22 p, 23 fig, 1 tab, 12 ref, append.

Descriptors: *Open channel flow, *Surges, *Simulation analysis, Digital computers, Computer models, Hydraulics, Numerical analysis, Open channels, Waves (Water), Closed conduit flow, Hydrograph analysis, Unsteady flow.
Identifiers: Open channel surges.

The equations of motion for unsteady gradually-varied flow in open channels are expressed in a finite-difference form suitable for programming on a high-speed digital computer. The staggered-net scheme introduced by Stoker is expanded to be applicable to a system of N interconnected channels, with each of their ends subject to one of the following boundary conditions: discharge hydrograph, stage hydrograph, stage-discharge relationship, dead end or junction of channels. The theory and computer program are tested and compared with existing experimental results corresponding to the following situations: (1) Flood hydrograph in circular channel; (2) power-load rejection in headrace of trapezoidal canal; (3) power-load acceptance in tailrace of rectangular model channel; and (4) tidal (stage hydrograph) in rectangular model estuary. Because of good correlation between simulated and experimental results in all four instances and the ease of coding various problems, the staggered scheme of Stoker is strongly recommended for practicing engineers. (Knapp-USGS)
W70-02459

LOCAL SCOUR AROUND BRIDGE PIERS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering
H. W. Shen, V. R. Schneider, and S. Karaki.
ASCE Proc, J Hydraul Div, Vol 95, No HY6, Pap 6891, p 1919-1940, Nov 1969. 22 p, 12 fig, 1 tab, 32 ref, append

Descriptors: *Scour, *Piers, Erosion, Stream erosion, Vortices, Turbulence, Eddies, Hydraulics, Sediment transport, Open channel flow, Steady flow, Bed load
Identifiers: Bridge pier scour

Local scour caused by the horseshoe vortex system which forms at the base of the piers is considered. Piers which induce a pressure field strong enough to cause the formulation of the horseshoe vortex system are termed 'blunt nosed', all others being classed as sharp-nosed piers. The condition of the sediment transported into and out of the scour hole forms the basis for the further classification of the scour process into clear-water scour and scour with continuous sediment motion. The pier Reynolds number is shown to be an important variable describing the strength of the horseshoe vortex system. Further, the equilibrium scour depth depends on the initial sediment transport condition for a steady uniform flow with fully developed bed material transport. Design criteria are proposed for blunt-nosed piers under the conditions of clear-water scour and scour with continuous sediment motion. Several deviations from the above ideal design conditions are discussed; methods for design in these cases are suggested. (Knapp-USGS)
W70-02462

COORDINATION IN MOBILE-BED HYDRAULICS,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
Thomas Blench.
ASCE Proc, J Hydraul Div, Vol 95, No HY6, Pap 6884, p 1871-1898, Nov 1969. 28 p, 9 fig, 31 ref, append.

Descriptors: *Sediment transport, *Alluvial channels, *Open channel flow, *Mathematical models, Bed load, Hydraulics, Streamflow, Model studies, Reviews, Research and development, Mathematical studies, Hydraulic models.
Identifiers: Mobile-bed hydraulics, Channel stabilization.

A mathematical study was made of bed-load transport in flumes, and two independent seven-dimensional functional relations among 'numerics' are established. The procedure was analogous to, but more complex than, producing the friction-factor diagram plot for Newtonian flow in uniform circular pipes. It is used to analyze the self-adjustment of natural channels and the transport of bed load in flumes. Different formulations are necessary to represent different flow, with transport phases advertised by different bed forms. Features of world data become apparent. Coordination of legitimately divergent formulas is seen to be necessary for an overall picture of the phenomena. Recommendations are made for improved cooperative international research covering the practically important range of independent variables. (Knapp-USGS)
W70-02463

NONLINEAR FLOW IN POROUS MEDIA,
Missouri Univ., Rolla. Dept. of Civil Engineering; and Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02F.
W70-02464

MOVEMENT OF SAND IN TUNNELS,
Norges Tekniske Hoegskole, Trondheim. River and Harbor Lab.
Dagfinn K. Lysne.
ASCE Proc, J Hydraul Div, Vol 95, No HY6, Pap 6880, p 1835-1846, Nov 1969. 12 p, 6 fig, 2 tab, 9 ref, append.

Descriptors: *Sediment transport, *Closed conduit flow, *Model studies, Erosion, Open channel flow, Hydraulic models, Particle size, Particle shape, Turbulence, Sands, Gravels, Tunnels.
Identifiers: Tunnel sediment transport.

The movement of sand and finely crushed rock in tunnels is investigated. A basic assumption is that the amount of transported material per unit time is low. Two problems have been distinguished and dealt with: (1) The general aspect of sand movement in a horizontal tunnel and; (2) the conditions for uniform sand movement in tunnels with variable slope. An analysis, based on present information of erosion in open channels, leads to equations for (1) calculating limiting size of particles being moved, and (2) the variation of cross section necessary to maintain uniform sand transport in long tunnels with variable slope. Coefficients are determined on the basis of laboratory tests and field data. (Knapp-USGS)
W70-02465

THE INTERPRETATION OF INTERFERENCE TESTS IN NATURALLY FRACTURED RESERVOIRS WITH UNIFORM FRACTURE DISTRIBUTION,
Atlantic Richfield Co., Dallas, Tex.
H. Kazemi, M. S. Seth, and G. W. Thomas.
Society of Petroleum Engineers Journal, Vol 9, No 4, p 463-472, Dec 1969. 10 p, 2 fig, 18 ref, 2 append.

Descriptors: *Drawdown, *Flow, *Mathematical models, *Porous media, *Permeability, Fractures (Geology), Pores, Transmissivity, Pumping, Well spacing, Withdrawal.
Identifiers: Double-porosity drawdown calculation, Interference tests.

The double-porosity model of Warren and Root for examining pressure drawdown and buildup phenomena in naturally fractured reservoirs has been extended to interpret interference test results. Both analytical and numerical solutions are presented. The practicality of some of the assumptions in the Warren-Root model was also investigated. The effects of well spacing and the magnitude of the interporosity flow parameter are briefly discussed. Another procedure for interpreting interference tests in naturally fractured reservoirs employs an equivalent homogeneous reservoir model, which is inadequate for early time responses, but for late time responses it yields favorable results. (Knapp-USGS)
W70-02469

AN INVESTIGATION OF THE FLOW REGIME FOR HELE-SHAW FLOW,
Shell Development Co., Houston, Tex., and Purdue Univ., Lafayette, Ind.
R. C. Smith, and R. A. Greenkorn.
Society of Petroleum Engineers Journal, Vol 9, No 4, p 434-442, Dec 1969. 9 p, 7 fig, 7 ref, append. Grant No 1797-A2, (Amer Chem Soc Petrol Res Fund)

Descriptors: *Flow, *Porous media, *Darcy's law, *Hydraulic models, Mathematical studies, Reynolds number, Model studies, Laboratory tests, Steady flow, Groundwater movement
Identifiers: *Hele-Shaw models.

Hele-Shaw cells are used to model creeping flow through porous media (where Darcy's law is valid). The effects of inertia on flow about obstructions in a Hele-Shaw cell can be calculated by a perturbation method by determining a solution to Laplace's equation. Results of a computer solution for flow about circular, square and elliptical obstructions are presented. For a modified Reynolds number of less than 1, the inertia terms are small; and for values of less than 3, the average streamline predicts the ideal flow. The analogy should be useful for studying flow in porous media up to a modified Reynolds number of at least 3. (Knapp-USGS)
W70-02470

FLOW BELOW DEEPLY SUBMERGED RECTANGULAR WEIRS,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02F.
W70-02472

AIR ENTRAINMENT BY FLOWING WATER UNDER REDUCED ATMOSPHERIC PRESSURE,
Engineering Labs., Cambridge (England)
For primary bibliographic entry see Field 02F.
W70-02474

JETS WITH NEGATIVE BUOYANCY IN HOMOGENEOUS FLUID,
Waterloopkundig Laboratorium, Delft (Netherlands).
For primary bibliographic entry see Field 02E.
W70-02715

A HYDRAULIC MODEL STUDY OF HEAT DISSIPATION AT KINCARDINE POWER STATION,
Williamson (James) and Partners, Glasgow (Scotland).
For primary bibliographic entry see Field 05B.
W70-02717

8C. Hydraulic Machinery

PLANNING FOR POWER - A LOOK AT TOMORROWS STATION SIZES,
Ebasco Services, Inc.
R. R. Bennett.
IEEE Spectrum, Vol 6 (9), p 67-72, 1968. 4 fig.
Identifiers: *Electrical system design, *Power growth surveys, *Systems engineering, *Turbine-generators, Air pollution, Boiling-water reactors, Cooling towers, Fossil fuels, Reactor siting, Single-purpose plant, Breeder reactors.

Predictions of the sizes of electric power generating stations for the year 1987 were made by superimposing the effects of availability of cooling water, availability of fuel, environmental limitations, electric system limitations, component design, manufacture, and shipment limitations, and land requirements on projections of the historical trends in load growth, unit size, and station size. U.S. peak electrical loads increased from 60,000 MW (E) to 225,000 MW (E) between 1947 and 1967 and are estimated to increase to 900,000 MW (E) in 1987. The average unit size increased from 38 MW (E) in 1947 to 280 MW (E) in 1967, the largest unit size increased from 100 MW (E) to 1000 MW (E), the average station size increased from 34 MW (E) to 200 MW (E), and the largest station size increased from 880 MW (E) to 1950 MW (E). For the year 1987 the largest unit size is predicted to be 3000 MW (E) and the largest station size 12,000 MW (E), the average unit size is predicted to be 1500 MW (E) and the average station size 4000 MW (E).
W70-02740

DESIGN OF A COMBINED SEWER FLUIDIC REGULATOR, THE DEVELOPMENT OF BASIC CONFIGURATIONS AND DESIGN CRITERIA FOR APPLICATIONS OF FLUIDS IN SEWER REGULATORS.
Bowles Engineering Corp., Silver Spring, Md.
For primary bibliographic entry see Field 04A.
W70-02773

8E. Rock Mechanics and Geology

OOLITIC ARAGONITE AND QUARTZ SAND: LABORATORY COMPARISON UNDER WAVE ACTION,
Army Coastal Engineering Research Center, Washington, D.C.
Frederick F. Monroe.
Available without charge from US Army Coastal Engineering Research Center, 5201 Little Falls Road, N.W., Washington, DC, 20016. Corps Engineers Coastal Engineering Research Center Miscellaneous Paper No 1-69, Apr 1969. 84 p, 58 fig, 5 tab, 7 ref, 3 append.

Descriptors: *Quartz, *Sands, *Carbonate rocks, *Sediments, *Erosion, *Laboratory tests, Waves (Water), Particle size, Beaches, Beach erosion, Coastal engineering, Test procedures, Fluorescence, Cost comparisons.
Identifiers: *Oolitic aragonite, Quartz sand, Beach nourishment.

The use of oolitic aragonite as a suitable beach fill material was investigated in laboratory tests and field studies. Results of the field study proved inconclusive but the laboratory tests show oolitic aragonite to be a suitable material hydraulically for beach nourishment if it can be placed on the beach at a cost competitive with other sand sources, and if the energy environment of the beach does not require a larger size material than in the oolitic aragonite. Detailed description of analytical procedures and many curves depicting the results of the studies are given. (Gabriel-USGS)
W70-02624

INVESTIGATION OF SOIL FREEZING,
Rhode Island Univ., Kingston. Dept. of Civil Engineering.
Wang Mian Chang.
PB-188 907. Technical Completion Report, Rhode Island Water Resources Center, 1969. 51 p, 1 tab, 28 fig, 19 ref. OWRR Project A-023-RI.

Descriptors: *Frost action, *Heave, Heat flow, Moisture migration, *Compacted soils.
Identifiers: *Soil freezing.

Study on the effect of some important factors on such frost behaviors of compacted soils as the rate and depth of frost penetration, water content increase and frost heaving is described. The factors investigated are the degree of saturation, molding water content, dry density and soil textures. The apparatus used included a cold chest, a reflecting type galvanometer and copper-constantan themocouples, a set of one thousandth inch dial gages and an X-ray machine. The experimental results show that increasing initial degree of saturation (for a constant dry density), decreasing dry density (for a constant degree of saturation), and decreasing the percentage of fine grain (0.002 mm.) content will decrease the rate of frost penetration, and that decreasing initial degree of saturation, increasing dry density and the percentage of fine grain content will decrease overall frost heaving. Frost heaving of soils compacted using a constant compaction effort, however, increases with increasing molding moisture content regardless of the change of dry density.
W70-02750

DYNAMIC BEHAVIOR OF SOIL,
Rhode Island Univ., Kingston. Dept. of Civil Engineering; and Rhode Isand Univ., Kingston. Dept. of Ocean Engineering.
Vito A. Nacci.
PB-188 904. Technical Completion Report, Rhode Island Water Resources Center, 1969. 45 p, 23 fig, 38 ref. OWRR Project A-016-RI.

Descriptors: *Elastic wave propagation, *Shear modulus, *Silt.
Identifiers: Anisotropy, *Stress-strain.

Investigation concerning the dynamic shear modulus of silt sedimented at different degrees of anisotropy are described. The influence of confining pressure and amplitude of vibration on the shear modulus was investigated. The resonant column method under fully saturated conditions was used to study the effects of the various parameters. The results show that the shear modulus of normally consolidated silt varies as the 7/10th power of the confining pressure. The modulus is also greatly influenced by strata orientation and void ratio. At relatively small amplitudes of vibration, less than 10-5 radians, the shear modulus is constant and can be considered to be the elastic dynamic shear modulus of the soil.
W70-02751

8F. Concrete

REVETMENTS FOR BANK PROTECTION USING VERY ROUGH-SURFACED FERRO-CONCRETE ELEMENTS (FRENCH),
Institut d'Amenagement et d'Economie de l'Eau, Warsaw (Poland).
For primary bibliographic entry see Field 08A.
W70-02696

SHORE EROSION AND PROTECTION ST. LAWRENCE RIVER-CANADA,
Department of Public Works (Canada).
For primary bibliographic entry see Field 08A.
W70-02697

8G. Materials

SIMULTANEOUS DETERMINATION OF BASIC GEOMETRICAL CHARACTERISTICS OF POROUS MEDIA,
Instituto Mexicano del Petroleo, Mexico.
Candelario Perez-Rosales.
Society of Petroleum Engineers Journal, Vol 9, No 4, p 413-416, Dec 1969. 4 p, 3 fig, 3 ref.

Descriptors: *Porous media, *Porosity, *Particle size, *Particle shape, *Permeability, Analytical techniques, Interstices, Pores, Void ratio, Voids, Laboratory tests.
Identifiers: Pore geometry.

A statistical method for determining simultaneously some of the basic geometrical characteristics of porous media such as porosity, specific surface, mean pore width, mean grain thickness and absolute permeability is presented. The proposed method is characterized by its simplicity and the minimum amount of laboratory equipment that it requires. The experimental procedure used is based upon the surface analysis of a sample. In view of this fact the applicability of the method is limited to homogeneous and isotropic materials. (Knapp-USGS)
W70-02466

SALT WATER CORROSION CONTROL BY ENVIRONMENT MODIFICATION,
Dow Chemical Co., Freeport, Tex. Texas Div.
Robert A. Legault.
Available from the Superintendent of Documents, US Government Printing Office, Wash DC, 20402, for $1.25 per copy. Office of Saline Water, Research and Development Progress Report No 438, Apr 1969. 116 p. OSW Contract 14-01-0001-1482.

Descriptors: *Corrosion control, *Inhibitors, *Desalination, *Deaeration, Water-treatment.
Identifiers: *Dissolved-oxygen, Pitting, Chromates, Phosphates.

This study was concerned with corrosion control through environment modification without regard to the possible contamination of product water or the possible production of a toxic desalination plant effluent by an additive. If a particular additive performs satisfactorily as a corrosion inhibitor, the elimination of any contamination can be studied as a separate problem. The efficient exclusion of dissolved oxygen from sea water will permit the use of mild steel in this environment at a temperature of 250 deg F. Contamination of the sea water with traces of dissolved oxygen is sufficient to cause a localized attack that is prohibitive even at low corrosion rate values. Additionally, data obtained in this program indicate that: 5052 aluminum can be used without additives in desalination applications, and the presence of dissolved oxygen is not detrimental; the addition of 50 ppm of a binary phosphate-chromate inhibitor to the sea water makes it possible to use mild steel in desalination environments containing dissolved oxygen; the addition of 50 ppm of bicarbonate ion to the sea water makes it possible to use 1100 aluminum in desalination applications when the pH is adequately controlled; the addition of 100 ppm of chromate ion to the sea water makes it possible to use 1100 aluminum, as well as 3003, 5554, and 6061 aluminum, in desalination applications. (Filban-Office of Saline Water)
W70-02689

ULTRASONIC DETECTION OF CALCIUM SULFATE SCALE ON METAL SURFACES,
Midwest Research Inst., Kansas City, Mo.
Fred R. Rollins, Jr.
Available from the Superintendent of Documents, US Government Printing Office, Wash DC, 20402, for $0.50 per copy. Office of Saline Water, Research and Development Progress Report No 444, June 1969. 39 p. OSW Contract 14-01-0001-1718.

Descriptors: *Scaling, *Calcium sulfate, *Ultrasonics, Heat transfer.
Identifiers: *Scale deposition, *Ultrasonic detection.

A study of ultrasonic reflectivity at liquid-metal interfaces where CaSO4 scale is also present has led to a technique which should be very useful for fixed-station scale detection in saline water conversion plants. The technique utilizes small high-t emperature transducers that can be soldered directly to the outside surface of heat-transfer tubes. The geometry is such that the ultrasonic beam produced by these transducers converges to a focal point along the center line of the heat-transfer tube, and then diverges to strike the opposite wall at normal incidence. With suitable electronic gear, the system provides nearly exponentially decaying echo trains at frequencies from a few megahertz up to 20 MHz. These echo trains remain remarkably stable at water temperatures as high as 280 deg F and flow velocities of 3 ft/sec. The decay rate of the echo train is strongly affected by the presence of scale on the inside surfaces of the heat transfer tube. The sensitivity of the technique for scale detection increases with increased frequency; but other problems, such as attenuation by the water, ultimately set an upper limit on a practical frequency. The decay rate also depends on the exact nature of the scale. For this reason, the current program did not establish an exact calibration, but the technique appears to be completely capable of detecting deposits with thicknesses of 1 mil or more. Further study and development should set a lower limit for detection of well below 1 mil. (Filban-Office of Saline Water)
W70-02690

SEA WATER CORROSION TEST PROGRAM,
Dow Chemical Company, Freeport, Tex.
O. Osborn, L. Rice, W. B. Russell, C. F. Schrieber, and J. C. Williams.
Available from the Superintendent of Documents, US Government Printing Office, Wash DC, 20402, for $1.25 per copy. Office of Saline Water, Research and Development Progress Report No 417, Mar 1969. 108 p. OSW Contract 14-01-0001-1090.

Descriptors: *Copper alloys, *Dissolved oxygen, *Deaeration, Corrosion, Pitting, Dissolved oxygen analyzers.
Identifiers: Electrochemical corrosion rate, Weight-loss measurements, pH.

A small, highly automated pilot plant which could simulate most of the water conditions encountered in a distillation plant was constructed. Coupon weight losses of selected metals were then determined under the variables of dissolved oxygen concentration, pH, temperature, velocity, and water replenishment rate. The program thus far has progressed through the copper alloy family of 90-10 CuNi (706), 70-30 CuNi (715), 60-40 CuNi (720), Aluminum Brass (687), Ars. Admiralty Brass (443), and Phos. Deoxidized Copper (122). All alloys show extremely low weight loss under low dissolved oxygen conditions. (Filban-Office of Saline Water)
W70-02691

EFFECT OF SURFACE POTENTIAL ON SCALE FORMATION,
TRW Systems Group, Redondo Beach, Calif.
B. D. Marcus, H. P. Silverman, and W. T. Isukamoto
Available from the Superintendent of Documents, US Government Printing Office, Wash DC, 20402, for $0.70 per copy. Office of Saline Water, Research and Development Progress Report No 393, Jan 1969. 79 p. OSW Contract 14-01-0001-1447.

Descriptors: *Scaling, *Calcium sulfate, *Heat transfer, *Distillation desalination.
Identifiers: *Heat exchange surfaces, *Nucleation site, *Crystal growth, Radioisotope technique.

An experimental program was performed to investigate the effect of surface potential on the formation of calcium sulfate scale on platinum electrodes. The earliest stages of scale formation (nucleation), involving very small deposits of CaSO4, were of primary interest. Consequently, extremely sensitive radioisotope techniques were used for the basic measurements. Supersaturated calcium sulfate solutions were prepared in a temperature-controlled vessel by mixing S35-labelled H2SO4 with a Ca (OH)2 slurry. Five clusters of five carefully prepared platinum electrodes (25 in all) were then immersed in this solution and held at various potentials for pre-determined periods of time. After immersion the electrodes were removed, rinsed of excess radioactive solution and dried. They were then counted for radioactivity (S35 decays by emission of a 0.167 MeV B-particle). The count rate was proportional to the total mass of CaSO4 deposited on a given area of electrode. After counting them, the electrodes were autoradiographed yielding a map of the number and distribution of scale deposits on the surface. Results of multiple experiments were compared in order to achieve a sufficiently large body of data for statistical significance. It was demonstrated that surface potential is indeed a pertinent variable in scale formation. (Filban-Office of Saline Water)
W70-02692

DEVELOPMENT OF A LOW-COST IRON-BASE ALLOY TO RESIST CORROSION IN HOT SEA WATER,
Westinghouse Electric Corp., Pittsburgh, Pa.
N. Pessall, F. C. Hull, and C. Liu.
Available from the Superintendent of Documents, US Government Printing Office, Wash DC, 20402, for $0.70 per copy. Office of Saline Water Research and Development Progress Report No 478, Sept 1969. 76 p. OSW Contract 14-01-0001-1828.

Descriptors: *Corrosion, *Pitting resistance, *Desalination, *Alloys, Metallurgy.
Identifiers: *Iron alloys, *Anodic polarization, Critical pitting potential, Multicomponent ferritic steel.

Iron-base alloys, ranging from binary alloys of Fe-Cr to multicomponent alloys based on Fe-Cr-Mo, have been prepared by levitation melting. The relative resistances of the alloys to pitting corrosion in deaerated synthetic sea water, at temperatures up to 250 deg F, have been evaluated on the basis of critical pitting potentials, Ecrit, obtained from anodic polarization measurements. Based on studies of synergistic interactions, the most promising ferritic steels for use in aqueous chloride environments have been found in the Fe-Cr-Mo-Co alloy system. A tentative correlation between Ecrit and d-shell character of the component elements of quaternary alloys based on Fe-Cr-Mo suggests that multi-component ferritic steels, containing Cr and Mo as major additives in combination with small concentrations of Mn, Co, Ni, and/or Cu, will have exceptionally high resistance to pitting attack in aqueous chloride media. (Filban-Office of Saline Water)
W70-02693

HISTORICAL, FIELD AND EXPERIMENTAL STUDIES OF THE SUEZ CANAL BANK PROTECTION,
Suez Canal Authority Research Center, Ismailia (Egypt); and International Commission for Irrigation and Drainage.
For primary bibliographic entry see Field 08A
W70-02698

METHODS OF BANK PROTECTION FOR PORT, INLAND WATER-WAY AND RIVER,
Toa Harbour Works Co. Ltd., Tokyo (Japan). Engineering Dept
For primary bibliographic entry see Field 08A
W70-02699

EVALUATION OF TITANIUM-PLATED STEEL IN A CHLORIDE ENVIRONMENT,
Solar, San Diego, Calif.
R. V. Warnock, and A. R. Stetson
Available from Superintendent of Documents, US Government Printing Office, Washington, DC 20402 for $0.70 per copy. Office of Saline Water, Research and Development Progress Report No 395, Jan 1969. 68 p. OSW Contract 14-01-0001-1441.

Descriptors: *Desalination, *Titanium, *Protective coatings, Pitting, Corrosion control.
Identifiers: *Titanium plating, *Plated low-carbon steels, *Fused salt plating, Electrolytic coating.

Deposition of titanium coatings on low-carbon steels was accomplished by both electrolytic and nonelectrolytic techniques. Two chemical systems (K2TiF6-NaF-LiF and K2TiF6-KF-LiF) were investigated and a 5 mole percent K2TiF6- eutectic NaF-LiF bath was selected for coating the majority of corrosion test specimens. Nonelectrolytic coatings were deposited at 1700 deg F and electolytic coatings were applied at 1550 deg F and 1.0 ampere/inch sq current density. The surface concentration of the 0.003-inch thick coatings was 95 percent or greater titanium and 5 percent or less iron. Boiling sea water, aerated, room temperature sea water, autoclave (280 deg F) and velocity effects corrosion tests showed the nonelectrolytic 0.003-inch thick coating to possess a corrosion resistance essentially equal to that of pure (A-70) titanium. The rate of coating deposition was found to be of prime importance in determining corrosion resistance because the deposition rate largely controls the coating composition (alloy versus intermetallic compound). (Filban-Office of Saline Water)
W70-02741

DEVELOPMENT OF A LOW-COST IRON-BASE ALLOY TO RESIST CORROSION IN HOT SEA WATER,
Westinghouse Electric Corp., Pittsburgh, Pa.
N. Pessall, F. C. Hull, N. Michael, and C. Liu.
Available from the Superintendent of Documents, US Government Printing Office, Washington, DC, 20402, for $0.75 per copy. Office of Saline Water, Research and Development Progress Report No 394, Jan 1969. 79 p. OSW Contract 14-01-0001-1447.

Descriptors: *Desalination, *Iron alloys, *Corrosion control, *Electrochemistry, Crystallography, Pitting.
Identifiers: *Iron-base alloys, *Anodic polarization, Critical potential, Passivation.

Iron-base alloys, ranging from binary alloys to multi-component alloys, containing as many as eleven different components have been prepared by levitation melting. Dynamic loop-tests at 250 deg F in deaerated sea water, as well as studies of anodic polarization curves carried out at room temperature in deaerated 0.1N NaCl solution, have been used to evaluate the relative corrosion behavior of the alloys. The investigations have indicated minimal effects of melting practice, processing procedure, and crystallographic texture on the corrosion of iron-base alloys in hot sea water. Based on the observation of synergistic alloying effects in Fe-Cr and Fe-Al alloys, future development of new corrosion resistant iron-base alloys is likely to be based on multi-component single phase alloys containing chromium and/or aluminum as major alloying components. Additions of

Co, Mo, Ni, Nb, Si, W, Ag, Zr, V, and Ti have all shown beneficial effects as alloying elements. A comparison of polarization measurements with loop-test data has indicated that, with certain precautions, the electrochemical method is to be preferred when evaluating new iron-base alloy compositions. (Filban-Office of Saline Water)
W70-02742

10. SCIENTIFIC AND TECHNICAL INFORMATION

RIVER ICE JAMS - A LITERATURE REVIEW,

United States Lake Survey, Detroit, Mich.

For primary bibliographic entry see Field 02C.
W70-02494

COMBATING POLLUTION CREATED BY OIL SPILLS, VOLUME I: METHODS,
Little (Arthur D.), Inc., Cambridge, Mass.
For primary bibliographic entry see Field 05G.
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VOLUME 3, NUMBER 8
APRIL 15, 1970

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WATER RESOURCES ABSTRACTS

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VOLUME 3, NUMBER 8
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Use of funds for printing this publication approved by the Director of the Bureau of the Budget, September 4, 1968.

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
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Office of Water Resources Research
U.S. Department of the Interior
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04 WATER QUANTITY MANAGEMENT AND CONTROL
Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Non-Water Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION
Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

LIBRARY

06 WATER RESOURCES PLANNING
Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA
Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS
Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES
Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION
Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

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ABSTRACT SOURCES

SELECTED WATER RESOURCES ABSTRACTS

02. WATER CYCLE

2A. General

PRECIPITATION AFFECTS INCREASES IN STREAMFLOW AFTER CONVERTING BRUSH TO GRASS IN ARIZONA,
Agricultural Research Service, Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
For primary bibliographic entry see Field 03B.
W70-02882

INVENTORY OF SPRINGS IN THE MOREY PEAK AREA OF CENTRAL NEVADA,
Geological Survey, Denver, Colo.
J. D. Larson, and J. E. Weir, Jr.
Geol Surv Open-file Report, Nov 1969. 22 p, 8 fig, 2 tab, 4 ref. AEC Contract AT (29-2)-474.

Descriptors: *Springs, *Discharge (Water), *Nevada, Groundwater, Water resources, Stock water, Domestic water, Water quality, Water temperature, Data collections, Hydrologic data.
Identifiers: Morey Peak (Nevada).

About 90% of springs above 2,134 meters (7,000 feet) altitude in lat 38 deg 30 min-38 deg 45 min N. long 116 deg 15 min-116 deg 27 min W., in central Nevada were inventoried; 10 springs issue from local valley-fill material of Quaternary age and 12 springs from volcanic material of Tertiary age. Springs used for stock or domestic supplies were emphasized during the inventory. Analysis of water samples collected July 22-30, 1968, indicate that hardness ranges from 35 to 506 mg/l and dissolved-solids content ranges from 74 to 584 mg/l. Water discharges and temperatures were measured and ranged from 0.5 to 220 cu m per day, and from 6.5 deg to 25.0 deg C. Analysis of water samples collected Oct 11-14, 1968, indicate that hardness ranges from 23 to 477 mg/l and dissolved-solids content ranges from 108 to 694 mg/l. Water discharges and temperatures were measured and ranged from 0.5 to 65 cu m per day and from 6.0 deg to 16.0 deg C. (Knapp-USGS)
W70-02883

A PROGRAM IN URBAN HYDROLOGY. PART II: AN EVALUATION OF RAINFALL-RUNOFF MODELS FOR SMALL WATERSHEDS AND THE EFFECTS OF URBANIZATION ON RUNOFF,
Purdue Univ., Lafayette, Ind. School of Civil Engineering.
P. B. S. Sarma, J. W. Delleur, and A. R. Rao.
Available from the Clearinghouse as PB-189 043, $3.00 in paper copy, $0.65 in microfiche. Purdue University Water Resources Research Center Technical Report No 9. Oct 1969. 240 p, 58 fig. 30 tab, 105 ref, 3 append. OWRR Project B-002-IND.

Descriptors: *Urbanization, *Storm runoff, *Watersheds, Water yield, Runoff, *Rainfall-runoff relationships, Hydrographs, Rainfall, Runoff coefficient, *Time lag, *Model studies, *Simulation.
Identifiers: Nash model, Single linear reservoir model, Double routing, West Lafayette Watershed.

The data for this study were taken from four watersheds with varying degrees of urbanization located in West Lafayette, Indiana. The analytical approach adopted was the linear (time variant, lumped) system analysis. The conceptual linear systems considered in the analysis of the data were the single linear reservoir model, the double routing method, the Nash model, and the single linear-reservoir with linear-channel model. The single linear reservoir model was selected to simulate the rainfall-runoff process on small urban watersheds (less than 5 square miles) based on its superior regeneration performance while the Nash model served best on the larger watersheds (between 5 and 20 square miles). The relationship of the degree of urbanization and the time lag, the magnitude of the peak discharge, and the frequency of peak discharge were studied. Studies will be continued with linear models and, in addition, nonlinear models will be considered in the hydrologic simulation of the larger watersheds in order to develop design methods and criteria for predicting runoff from areas with varying degrees of urbanization.
W70-03035

A DISPERSION ANALOG MODEL FOR WATERSHED SYSTEMS,
Technion - Israel Inst. of Tech., Haifa.
M. H. Diskin.
Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 6, p 38-45, 1967. 8 p, 5 fig, 16 ref.

Descriptors: *Rainfall-runoff relationships, *Model studies, *Hydraulic models, *Analog models, Tracers, Runoff forecasting, Hydrograph analysis, Unit hydrographs, Dispersion, Simulation analysis.
Identifiers: *Rainfall-runoff models, Israel, Watershed models.

A watershed system may be simulated by means of a model consisting of a wide gravel covered channel or tray in which a steady flow of water is maintained. The water enters the channel at a number of points and leaves it at one outlet. The varying times of travel from various parts of the watershed are simulated in the model by imposing on it a velocity field, which is defined by the shape of the tray, by the arrangement of the gravel in the tray and by the arrangement of the points at which the steady inflow of water is introduced. Rainfall is simulated in the above model by injecting concentrated salt solution at the various parts of the watershed model or over its entire surface. Runoff is simulated by the concentration of salt in the water flowing out from the model. The concentration is continuously measured and its variation with time represents the outflow hydrograph. The responses to short duration inputs obtained in the various models tested were all positively skewed distribution in the form typical to instantaneous unit hydrographs from actual watersheds. The form of the impulse response depended on the extent and on the areal distribution of the incoming pulse. Simulation of short duration storms moving upstream or downstream in the model watersheds indicated significant changes in the form of the outflow hydrographs in comparison to a stationary storm of the same duration and rainfall. (Knapp-USGS)
W70-03128

A SIMULATED WATERSHED FLOW SYSTEM FOR HYDROGRAPH PREDICTION; A KINEMATIC APPLICATION,
Agricultural Research Service, Beltsville, Md. Hydrograph Lab.
D. L. Brakensiek.
Proceedings International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 3, p 18-24, 1967. 7 p, 3 fig, 1 tab, 6 ref.

Descriptors: *Rainfall-runoff relationships, *Routing, *Mathematical models, *Synthetic hydrology, Unit hydrographs, Runoff forecasting, Simulation analysis, Rainfall disposition, Streamflow forecasting.
Identifiers: Kinematic flow theory.

The upland watershed has generally been treated as a lumped system, that is, one in which graphs are predicted by the unit hydrograph theory or by a routing technique utilizing a reservoir storage analog. An upland watershed may be transformed into a one-dimensional flow system. Simple kinematic flow equations are utilized to route estimated rainfall excess. An example indicates that the computational system is feasible for predicting hydrographs. Hydrologic parameters of the watershed as a function of elevation can be introduced and evaluated as modifiers of the watershed hydrologic performance. (Knapp-USGS)
W70-03129

USE OF LOG-TRANSFORMATION TO THE ANALYTICAL REPRESENTATION OF RIVER RUNOFF,
Hokkaido Univ., Sapporo (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-03130

RUNOFF ANALYSIS AND WATER-BALANCE ANALYSIS BY A SERIES STORAGE TYPE MODEL,
National Research Center for Disaster Prevention, Tokyo (Japan).
Masami Sugawara.
Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 5, p 31-37, 1967. 7 p, 12 fig.

Descriptors: *Rainfall-runoff relationships, *Mathematical models, *Water storage, *Routing, Hydrograph analysis, Unit hydrographs, Rainfall intensity, Rainfall disposition, Evapotranspiration, Infiltration, Synthetic hydrology.
Identifiers: *Japan.

Storage type models are based on the hypothesis that both discharge and infiltration are functions of the amount of water stored in the ground, and which can be simulated approximately by a vessel having some outlets at the side and an outlet at the bottom. Although it can represent automatically the nonlinear character of the runoff phenomena, the storage model is not very sensitive to the precipitation intensity. The series storage model modifies this defect by using a vertical series of storage-type structures. This model gives good results in runoff analysis of Japanese rivers. Runoff structures of the river basins differ, but rivers in volcanic terraines have uniform large groundwater inflows, and their hydrographs are flat and smooth. The effect of soil moisture need not be considered in Japan where there is no dry season and the soil is nearly always wet. As the soil is always wet, we need not separate the actual evapotranspiration from the potential one. The runoff analysis of snowy basins is possible by dividing them into several zones. Though the series storage-type model gives good results for Japanese rivers, some modification must be necessary for the basins of nonhumid regions or of the regions where there is a half-year dry season. (Knapp-USGS)
W70-03131

ANALYTICAL SIMULATION OF WATERSHED HYDROGRAPHS FROM RAINFALL,
Agricultural Research Service, Beltsville, Md. Hydrograph Lab.
D. E. Overton.
Proceedings International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 2, p 9-17, 1967. 9 p, 2 fig, 20 ref.

Descriptors: *Rainfall-runoff relationships, *Routing, *Mathematical models, *Synthetic hydrology, *Runoff forecasting, Simulation analysis, Hydrologic budget, Rainfall disposition, Hydrographs, Unit hydrographs.
Identifiers: Hydrograph simulation.

Upland watershed hydrographs are usually estimated using unit hydrograph techniques. In view of the apparent vagaries of the unit hydrograph from storm to storm and the computational tedium involved in summations, new approaches are presented which may relieve these difficulties. The hydrologic reaction of the watershed is considered as a series of linear reservoirs in one approach and as a group of nonlinear reservoirs acting in parallel in another approach. Bases for estimation of the routing parameters are presented in an attempt to relate them to the physical characteristics of the watershed and the supply rate of the storm. (Knapp-USGS)
W70-03132

A DISTRIBUTED LINEAR MODEL FOR PEAK CATCHMENT DISCHARGE,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Land Research and Regional Survey.
Peter S. Eagleson.
Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 1, p 1-8, 1967. 8 p, 1 fig, 11 ref.

Descriptors: *Rainfall-runoff relationships, *Runoff forecasting, *Routing, *Rainfall disposition, Rainfall intensity, Peak discharge, Linear programming, Synthetic hydrology, Unit hydrographs, Mathematical models.
Identifiers: Kinematic wave theory.

The kinematic wave solution for surface runoff is used to obtain the contribution to peak discharge from an impulse of rainfall excess located at distance x from the catchment outlet. This spatial impulse response is employed in a linearization of the catchment dynamics to obtain a simple superposition relation for estimating the effect of areal variability in rainfall distribution upon the peak surface runoff. (Knapp-USGS)
W70-03133

A MATHEMATICAL WATERSHED ROUTING MODEL,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
R. E. Machmeier, and C. L. Larson.
Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 9, p 64-71, 1967. 8 p, 2 fig, 10 ref.

Descriptors: *Rainfall-runoff relationships, *Routing, *Mathematical models, *Streamflow forecasting, *Runoff forecasting, Simulation analysis, Computer models, Rainfall disposition, Rainfall intensity, Unsteady flow.
Identifiers: Watershed routing models.

A mathematical model of a 21.35-sq mi hypothetical watershed was developed. All of the channel characteristics are defined mathematically. Input to the watershed is rainfall excess of any selected rate and duration. The unsteady flow is routed through the channel system by the use of the partial differential equations of momentum and continuity in finite difference form. The watershed can be used to study the effects of supply rate and duration as well as physical characteristics of the watershed that effect the hydrologic process. (Knapp-USGS)
W70-03134

A CONTRIBUTION TO ANALOGUE AND PHYSICAL MODELING OF SURFACE RUNOFF PROCESS IN SMALL BASINS,
For primary bibliographic entry see Field 07C.
W70-03135

URBAN STORM DRAINAGE CRITERIA MANUAL.
Wright-McLaughlin Engineers, Denver, Colo.
For primary bibliographic entry see Field 04A.
W70-03148

RAINFALL FOR THE DENVER REGION, (Chapter 4), AND RUNOFF, (Chapter 5).
Wright-McLaughlin Engineers, Denver, Colo.
For primary bibliographic entry see Field 04A.
W70-03151

2B. Precipitation

A REVIEW OF PROJECT FOG DROPS,
Cornell Aeronautical Lab., Inc., Buffalo, N.Y.
Roland J. Pilie.
Report available from Clearinghouse for $3.00 in paper copy, $0.65 in microfiche. NASA Special Publication Report SP-212, Proceedings of Symposium held at NASA Headquarters, Wash, DC, p 1-23, Feb 6, 1969. 23 p, 12 fig, 1 tab, 7 ref.

Descriptors: *Fog, *Reviews, *Weather modification, Cloud physics, Atmospheric physics, Cloud seeding, Nucleation, Halides, Meteorology, Weather, Research and development.
Identifiers: Fog dispersal, Visibility, Fog physics.

A general review is given of a project to investigate basic warm fog properties and dynamics, and to evaluate suggested methods for suppression of warm fog. Investigations of basic fog properties included literature studies, fog modeling, fog climatologies, experimental investigations aimed at the description of fog, and studies of condensation nuclei that are activated to droplet growth in fog. These studies were all aimed at the development of a better understanding of what fog is, how it forms and why it creates a problem. (Knapp-USGS)
W70-02857

PROGRESS OF NASA RESEARCH ON WARM FOG PROPERTIES AND MODIFICATION CONCEPTS.

Report available from Clearinghouse for $3.00 in paper copy, $0.65 in microfiche. NASA Special Publication Report SP-212, Proceedings of Symposium held at NASA Headquarters, Wash, DC, Feb 6, 1969. 122 p, 44 fig, 6 tab, 14 ref.

Descriptors: *Fog, *Cloud seeding, *Reviews, Weather modification, Clouds, Nucleation, Silver iodide, Halides, Cloud physics, Meteorology, Weather, Airports.
Identifiers: Fog dispersal, Visibility, Airport operation.

A NASA symposium was held to review recent work in warm fog dispersal. Theoretical analyses and laboratory experiments were used to explore various warm fog modification concepts and catalog the noteworthy aspects of each concept. The seeding concept using sized hygroscopic nuclei was developed and tested in fog chamber experiments. The small amounts of the seeding material needed to significantly modify the fog and greatly increase visibility in these experiments were encouraging. The Symposium is a progress report, recognizing that there is work yet to be done before warm fog will no longer be an obstacle to routine aircraft operation. One objective was to provide results of recent warm fog seeding field experiments at the Chemung County Airport, Elmira, New York, and laboratory experiments at the Cornell Aeronautical Laboratory facility to evaluate several seeding materials. Another objective was to provide a forum for others to present and discuss their fog research programs and for aircraft users to define the operational needs of a practical fog modification system for airports. (Knapp-USGS)
W70-02858

GROUNDWATER INVESTIGATION, MOUNT KOBAU, BRITISH COLUMBIA,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
For primary bibliographic entry see Field 02F.
W70-02867

THE PRECIPITATION REGIME OF LONG ISLAND, NEW YORK,
Weather Bureau, Silver Spring, Md.
J. F. Miller, and R. H. Frederick.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC, 20402. Geological Survey Professional Paper 627-A, p A1-A21, 1969. 21 p, 23 fig, 1 plate, 7 tab, 16 ref.

Descriptors: *Precipitation (Atmospheric), *Weather, *Climates, *New York, Hydrologic cycle, Rainfall, Synoptic analysis, Weather data, Data collections, Climatic data, Climatology, Meteorological data, Weather patterns.
Identifiers: *Long Island (NY).

Mean annual precipitation ranges from 40 to 50 inches over Long Island, New York and averaged about 43 inches for the analysis period 1951-65. The average precipitation is greatest over the central part of the Island. This may be due to (1) greater distance of this area from the stabilizing effects of the Atlantic Ocean and Long Island Sound, and (2) its slightly higher altitude. Average warm-season and cool-season precipitation are almost equal. The number of days with precipitation equal to or less than 1.00 inch is randomly distributed geographically but shows a definite seasonal variation, being greatest in the spring and least in the fall. The number of days with precipitation of more than 1.00 inch and the amount of rain that falls on such days are both highly correlated with average seasonal and monthly precipitation. About 5-10% of the water equivalent of cool-season precipitation is in the form of snow. (Knapp-USGS)
W70-02881

SEASONAL VARIATION IN RAIN GAGE CATCH,
Department of Agriculture, Washington, D.C.; and Weather Bureau, Silver Spring, Md.
For primary bibliographic entry see Field 07B.
W70-03086

RAINFALL FOR THE DENVER REGION, (Chapter 4), AND RUNOFF, (Chapter 5).
Wright-McLaughlin Engineers, Denver, Colo.
For primary bibliographic entry see Field 04A.
W70-03151

2C. Snow, Ice, and Frost

LICHENOMETRY TO EVALUATE CHANGES IN GLACIAL MASS BUDGETS: AS ILLUSTRATED FROM NORTH-CENTRAL BAFFIN ISLAND, N.W.T.,
Colorado Univ., Boulder. Inst. of Arctic and Alpine Research; and Colorado Univ., Boulder. Dept. of Geological Sciences.
For primary bibliographic entry see Field 02I.
W70-02873

GLACIAL GEOMORPHOLOGY AND CHRONOLOGY OF HENRY KATER PENINSULA, EAST BAFFIN ISLAND, N.W.T.,
Nottingham Univ. (England). Dept. of Geography.
Cuchlaine A. M. King.
Arctic and Alpine Research, Vol 1, No 3, p 195-212, Summer 1969. 18 p, 11 fig, 2 tab, 16 ref.

Descriptors: *Glaciation, *Glaciers, *Geomorphology, *Arctic, *Sediments, Ice, Marine geology, Fjords, Mountains, Valleys, History, Mapping, Erosion, Rivers, Lakes, Deltas, Sea level, Stratigraphy.
Identifiers: *Canada, East Baffin Island, Glacial geomorphology.

Henry Kater Peninsula, East Baffin Island, was ice covered at least between 34,000 and 10,000 BP. The ice advanced into the sea along the outer part of the peninsula, spreading a thin morainic covering over shell-bearing marine sediments. Ice moved inland from the fjords along the margins of the peninsula, while ice from inland covered the interior. Much ice decayed in situ, leaving extensive dead-ice areas. The sea was relatively high as the ice withdrew. Deglaciation took place about 10,000 BP at the outer coast, about 8,500 BP in Isabella Bay on the north side, and 8,000 BP in Itirbilung Bay on the south side. The last major incursion of fjord ice into the embayments along the inner peninsula was approximately 8,700 and 8,000 BP. This moraine may be contemporaneous with the Cockburn moraines. The ice-cored moraines of the present glaciers in the mountain valleys have been static for several years. (Gabriel-USGS)
W70-02874

HYDRATE REACTION KINETICS AND ICE CRYSTAL GROWTH RATES: 1. THE GROWTH RATE OF ICE CRYSTALS IN FLOWING SUB-COOLED WATER,
Syracuse Univ., N.Y.
For primary bibliographic entry see Field 03A.
W70-03073

HYDRATE REACTION KINETICS AND ICE CRYSTAL GROWTH RATES: 2. THE RATE OF FORMATION OF FREON 31 HYDRATE,
Syracuse Univ., N.Y.
For primary bibliographic entry see Field 03A.
W70-03074

THE EFFECTS OF THERMAL POLLUTION ON RIVER ICE CONDITIONS: 2. A SIMPLIFIED METHOD OF CALCULATION,
Army Terrestrial Sciences Center, Hanover, N.H.
For primary bibliographic entry see Field 05C.
W70-03089

2D. Evaporation and Transpiration

COMPARISON OF VARIOUS METHODS OF DETERMINING EVAPORATION IN AN IRRIGATED FIELD IN THE VAKHSH VALLEY OF TADZHIKISTAN,
L. P. Lapshova.
Transl from Trudy GGO, No 230, p 109-116, 1968. Soviet Hydrology: Selected Papers, No 4, p 354-359, 1968. 2 fig, 2 tab, 16 ref.

Descriptors: *Thermal radiation, *Evaporation, Irrigated land, Lysimeters, Cotton, Evapotranspiration, Soils, Soil moisture.
Identifiers: *USSR, Tadzhikistan, Vakhsh Valley.

Thermal-balance was found to be the best method for determining the total evaporation from the cotton-growing areas. Lysimetry is another method used in irrigated regions. Total evaporation in the Vakhsh Valley, Tadzhikistan can be computed from the radiation balance of an irrigated field. However, this method yields reliable results only during the budding-flowering and ripening phases of the cotton. Evaporimeter data can be used to calculate evaporation when information on the radiation balance is not available. (Carstea-USGS)
W70-03116

EVAPORATION WATER LOSSES UNDER SPRINKLING IRRIGATION CONDITIONS (RUSSIAN),
All-Union Research Inst. for Water Engineering and Reclamation, Moscow (USSR).
V. A. Anisimov, and M. S. Mansurav.
Gidrotekhnika i Melioratsiya, No 8, p 37-43, Aug 1969. 5 fig, 1 tab, 10 ref.

Descriptors: *Evaporation, *Water loss, *Sprinkler irrigation, *Air temperature, Irrigation systems, Crop production, Pipelines, Raindrops, Humidity, Wind velocity, Meteorology.
Identifiers: *USSR, Sprinkling irrigation water loss.

The effects of wind, air temperature, type of crop, and sprinkler-nozzle dimension on water loss by evaporation, using sprinkler irrigation, were analytically and experimentally investigated during 1965-1967. In arid areas, the use of minimal sprinkling intensity is justified only until a limit is reached. Discrete sprinkling of low intensity covering a small area may lead to a considerable water loss by evaporation from the plant leaves. (Gabriel-USGS)
W70-03121

COMPARATIVE PLANT WATER RELATIONS,
Aberdeen Univ. (Scotland). Dept. of Botany.
P. G. Jarvis.
Annals of Arid Zone, Vol 6, No 1, p 74-91, 1967. 101 ref.

Descriptors: *Soil-water-plant relationships, *Leaves, *Moisture stress, *Atmosphere, *Transpiration, Plant growth, Metabolism, Field capacity, Stomata, Drought resistance, Root distribution, Solar radiation, Heat balance, Osmotic pressure, Turgidity, Plant physiology, Surfaces, Moisture content, Soil moisture.
Identifiers: *Water potential.

A review is made of the extensive modern literature on plant-water relations and plant physiology to develop a broad discussion of current knowledge of water relations within plants and ways that different features of species may affect their response to a limited water supply. Transpiration is an energy-dependent process; when water is freely available the transpiration rate depends largely on atmospheric conditions. With moisture stress the system ceases to be the direct result of atmospheric conditions but is modified by the plant. Effects of moisture stress on plant metabolism and growth are influenced by 2 groups of plant factors: (1) Those factors affecting water potential in leaves: rooting habit of the plant, resistance to water passage from roots to leaves, and influence of plant surfaces on transpiration, (2) Influence of leaf water potential on physiology of growth: relationship between leaf water potential and turgidity, relationship between turgidity and stomatal aperture and direct effects of low turgidity and water potential on metabolism. Each of these aspects is presented individually with quantitative expressions developed where possible and relevant. Possible differences in influence of the various factors in different types of plants are also discussed. There are many plant factors of varying importance which determine the response of a particular plant population to water stress. None of these has been studied in sufficient detail to make objective assessments of its relative importance among the species. (Crouse-Arizona)
W70-03239

2E. Streamflow and Runoff

FLOOD PLAIN INFORMATION, AMERICAN FORK AND DRY CREEK, AMERICAN FORK AND LEHI, UTAH.
Corps of Engineers, Sacramento, Calif.
For primary bibliographic entry see Field 04A.
W70-02866

WATER AND RELATED LAND RESOURCES, CENTRAL LAHONTAN BASIN - WALKER RIVER SUBBASIN NEVADA-CALIFORNIA.
Nevada River Basin Survey, Carson City.

Department of Agriculture Cooperative Survey Report, June 1969. 232 p, 23 fig, 75 photo, 9 map, 39 tab, 103 ref, 2 append.

Descriptors: *Water resources, *Groundwater, *Surface waters, *Nevada, *California, Water yield, Water utilization, Streamflow, Aquifers, Irrigation water, Domestic water, Economics, Water resources development, Water management (Applied), Water rights, Water law.
Identifiers: *Walker River (Nev-Calif).

A report of the water resources of Walker River Subbasin, Calif-Nev, includes an inventory of the natural resources and problems; an analysis of economic development; a short discussion of existing resource projects and programs; and an indication of the opportunities for development. The Walker River Subbasin is one of three subbasins within the Central Lahontan Basin. Of the 2,733,660 acres in the subbasin, 595,700 acres are in California and 2,137,960 acres in Nevada. The Walker River drainage heads in the Sierra Nevada in California, and flows into Nevada, where it terminates in Walker Lake. Presently, about 119,870 acres are irrigated, with alfalfa and pasture the chief crops grown. The 50% chance water yield (5 out of 10 yr) was approximately 396,800 acre-feet; the 80% chance water yield is about 293,600 acre-feet. An estimated 232,600 acre-ft are used by the crops from surface flows. Approximately 34,600 acre-ft were pumped from groundwater in the two major irrigated valleys (Smith and Mason Valleys), in 1964. Total amount of water available from underground sources is estimated to be 6,500,000 acre-ft; however, total recharge to the groundwater supply is only about 206,000 acre-ft; during a 50% chance water year. Much of the subbasin is subject to both wet- and dry-mantle floods. (Knapp-USGS)
W70-02868

FORECASTING THE RHINE RIVER DISCHARGES (FRENCH),
Electricite de France, Grenoble. General Technical Div.
F. Lugiez, P. Kasser, H. Jensen, and P. Guillot.
English summary. Bulletin of the International Association of Scientific Hydrology, Vol 14, No 3, p 91-116, Sept 1969. 26 p, 14 fig, 6 tab, 24 ref.

Descriptors: *Stream flow forecasting, *River flow, *Flood forecasting, Hydrologic data, Lakes, Rainfall, Snow, Runoff, Seasonal, River basins, Watersheds (Basins), Mapping, Gaging stations, Statistical methods, Hydrograph analysis, Correlation analysis, Frequency.
Identifiers: *Rhine river, Discharge forecasting.

Forecasts of the discharge of the Rhine River have been studied in Zurich since 1954 in cooperation with the power and water management organizations of Switzerland, Germany, France, and the Netherlands. Annual forecasts are made of the water yield from snowmelt data. For short-term forecasts, the significant predictors are discharge and rainfall, and for long-term forecasts, the alpine snow pack and the levels of the Swiss lakes play an important role. These forecasts are used by the hydropower plants in their operation programs, maintenance, and proper timing of construction work. (Gabriel-USGS)
W70-02884

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, PASCAGOULA QUADRANGLE, MISSISSIPPI,
Geological Survey, Washington, D.C.
K. V. Wilson, and James W. Hudson.
For sale by the US Geological Survey, Map Division, Wash, DC, 20240, for $0.75 per copy. Geol Surv Hydrol Invest Atlas HA-406, 1 sheet, 1969. Text, 2 fig, 1 map, 1 tab, 3 ref.

Descriptors: *Floods, *Mississippi, *Hurricanes, *Flood damage, *Coasts, Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Winds, Disasters, Storms, Waves (Water), Water levels, Water level fluctuations, Inlets (Waterways), Sea level, Shores.
Identifiers: *Hurricane Camille (1969), Pascagoula (Miss), Tidal floods, Storm tides.

The areas flooded by Hurricane Camille tides of August 18, 1969 along the Mississippi Gulf Coast are shown in a series of hydrologic atlases. The Atlas of the Pascagoula quadrangle shows flooded areas on a topographic map scaled 1:62,500. Camille was the most intense hurricane on record to enter the U.S. mainland. Estimated maximum winds were 190 mph, and the central pressure was 26.61 inches of mercury. The eye of the storm, traveling about due north, passed over the Waveland-Bay St. Louis area and winds of over 75 mph extended about 50 mi on each side. Maximum precipitation was 10 inches. Flooding was most severe in the Pass Christian area where tides reached 25 ft above msl. High tide frequency and annual maximum tide are shown by graphs. (Knapp-USGS)
W70-02888

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, GRAND BAY QUADRANGLE, ALABAMA,
Geological Survey, Washington, D.C.
K. V. Wilson, and J. W. Hudson.

For sale by the US Geological Survey, Map Division, Wash, DC, 20240, for $0.75 per copy. Geol Surv Hydrol Invest Atlas HA-408, 1 sheet, 1969. Text, 2 fig, 1 map, 1 tab, 3 ref.

Descriptors: *Floods, *Alabama, *Hurricanes, *Flood damage, *Coasts, Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Winds, Disasters, Storms, Waves (Water), Water levels, Water level fluctuations, Inlets (Waterways), Sea level, Shores.
Identifiers: *Hurricane Camille (1969), Grand Bay (Ala), Tidal floods, Storm tides.

The areas flooded by Hurricane Camille tides of August 18, 1969 along the Miss. - Ala. Gulf Coast are shown in a series of hydrologic atlases. The Atlas of the Grand Bay quadrangle shows flooded areas on a topographic map scaled 1:24,000. Camille was the most intense hurricane on record to enter the U.S. mainland. Estimated maximum winds were 190 mph, and the central pressure was 26.61 inches of mercury. The eye of the storm, traveling about due north, passed over the Waveland-Bay St. Louis area and winds of over 75 mph extended about 50 mi on each side. Maximum precipitation was 10 inches. Flooding was most severe in the Pass Christian area, Miss. where tides reached 25 ft above msl. High tide frequency and annual maximum tide are shown by graphs. (Knapp-USGS)
W70-02889

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, BILOXI QUADRANGLE, MISSISSIPPI,
Geological Survey, Washington, D.C.
K. V. Wilson, and James W. Hudson.
For sale by the US Geological Survey, Map Division, Wash, DC, 20240, for $0.75 per copy. Geol Surv Hydrol Invest Atlas HA-404, 1 sheet, 1969. Text, 2 fig, 2 photo, 1 map, 3 ref.

Descriptors: *Floods, *Mississippi, *Hurricanes, *Flood damage, *Coasts, Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Winds, Disasters, Storms, Waves (Water), Water levels, Water level fluctuations, Inlets (Waterways), Sea level, Shores.
Identifiers: *Hurricane Camille (1969), Biloxi (Miss), Tidal floods, Storm tides.

The areas flooded by Hurricane Camille tides of August 18, 1969 along the Mississippi Gulf Coast are shown in a series of hydrologic atlases. The Atlas of the Biloxi quadrangle shows flooded areas on a topographic map scaled 1:24,000. Camille was the most intense hurricane on record to enter the U.S. mainland. Estimated maximum winds were 190 mph, and the central pressure was 26.61 inches of mercury. The eye of the storm, traveling about due north, passed over the Waveland-Bay St. Louis area and winds of over 75 mph extended about 50 mi on each side. Maximum precipitation was 10 inches. Flooding was most severe in the Pass Christian area where tides reached 25 ft above msl. High tide frequency and annual maximum tide are shown by graphs. (Knapp-USGS)
W70-02890

CAUSES OF FLOODING OF LITTLE CHARLEY BOWLEGS CREEK UPSTREAM FROM HIGHLANDS HAMMOCK STATE PARK, FLORIDA,
Geological Survey, Tallahassee, Fla.
W. R. Murphy, Jr.
Geological Survey Open-file Report, 1968. 16 p, 11 fig

Descriptors: *Flooding, *Florida, *Stage-discharge relations, Dams, Profiles, Flood damage, Rainfall-runoff relationships, Regulation, Streamflow, Backwater, Flow profiles, Reservoirs, Water levels.
Identifiers: Highland Hammocks State Park (Fla).

Complaints of flooding on Little Charley Bowlegs Creek, Florida, led to an investigation of the effects of a dam in Highlands Hammock State Park on backwater conditions upstream in low-lying pastures. The concrete dam creates a nearly level conservation pool within the park during low water. Little or no backwater from the dam (without flashboards) extends beyond the park boundary during flood stages. The lowlands upstream from the park form a broad, flat marsh that would experience flooding following heavy rains even if there were no dam. No channel constrictions occur within the park which would cause backwater in the park or upstream from the park. The channel upstream from the south park boundary is inadequate to convey flood flows to the park because of: (1) lack of adequate slope, (2) small cross-sectional area, and (3) its clogged condition due to vegetation. Flooding of lowlands upstream from the park is attributable chiefly to these factors. (Knapp-USGS)
W70-03071

ON THE VALIDITY OF UNIT HYDROGRAPH THEORY,
Illinois Univ., Urbana. Dept. of Civil Engineering.
Ben Chie Yen, Basil Anderson, and Ven Te Chow.
Paper presented at 50th Annual Meeting of American Geophysical Union, Wash, DC, Apr 21-25, 1969. 20 p. NSF Grant GK-1155.

Descriptors: *Hydrograph analysis, *Theoretical analysis, *Dimensional analysis, *Rainfall-runoff relationships, Runoff, Froude number, Reynolds number, Laminar flow, Turbulent flow, Unit hydrographs.
Identifiers: Kinematic wave theory.

Through dimensional analysis and the examination of the characteristics of the equation of motion describing watershed runoffs it is demonstrated that the linearity assumption of the unit hydrograph theory is only an approximation. The Reynolds number, R, and Froude number, F, of the flow and a parameter expressing surface detention storage are the important factors affecting the shape of the unit hydrograph. Quantitative evidence of the approximation of the linearity assumption is given by approximate theoretical solutions based on (1) Stokes range flow and (2) kinematic wave theory applied to both laminar and turbulent flow. Laboratory and field experimental data are also analyzed and the nonlinear characteristics of the unit hydrograph are clearly shown. (Carstea-USGS)
W70-03076

THE NORTH BOSQUE WATERSHED INVENTORY OF A DRAINAGE BASIN,
Baylor Univ., Waco, Tex. Dept. of Geology.
Cleo V. Proctor, Jr.
Report available for sale from Department of Geology, Baylor University, Waco, Texas, 76703, Price $1.04 postpaid. Baylor Geological Studies Bulletin No 16, Spring 1969. 40 p, 26 fig, 3 tab, 51 ref, append.

Descriptors: *River basins, *Texas, *Hydrologic data, *Data collections, Surveys, Watersheds (Basins), Streamflow, Sediment yield, Erosion, Geomorphology, Floods, Topography, Rainfall-runoff relationships, Geology, Hydrogeology, Water quality.
Identifiers: *North Bosque Watershed (Tex).

The geomorphology of the four physiographic regions within the North Bosque watershed, Texas, is directly related to the properties of the rocks outcropping within those regions, and a dynamic equilibrium exists between erosional energy and topography. Landforms are being downwasted at the same rate, and differences in relief and form can be explained in terms of spatial relationships rather than evolutionary development through time. Because of the location of the North Bosque watershed, flood discharges reaching the magnitude of 500,000 cfs can be expected during a long period of record. Sheet erosion is the major sediment producer in the North Bosque watershed. Sheet erosion lowers the land surface by a maximum of approximately 0.095 cm/yr. Solution is also important and lowers the land surface by approximately 0.0012 cm/yr. In the North Bosque watershed several empirical relationships are given to relate geomorphology, hydrology, and erosional energy. (Knapp-USGS)
W70-03077

FLOOD PLAIN INFORMATION, KERN RIVER, BAKERSFIELD, CALIFORNIA.
Corps of Engineers, Sacramento, Calif.
For primary bibliographic entry see Field 04A.
W70-03090

WATER, EARTH AND MAN: 2. WORLD WATER INVENTORY AND CONTROL,
Geological Survey, Washington, D.C.
R. L. Nace.
London, England, Methuen and Company, Limited, p 31-42, 1969. 12 p, 2 tab, 11 ref.

Descriptors: *Water resources, *Water storage, *Water resources development, *Surveys, Groundwater, Surface waters, Water sources, Reviews, Water quality, Rivers, Lakes, Ice, Glaciers.
Identifiers: Water resources inventories.

The status of the world's water inventory activity is briefly outlined in a chapter of a broad survey of Man's relation to water resources. The topics reviewed include uses of water resources inventories, the hydrologic cycle, river discharge, channel storage, lakes, inland seas, groundwater storage, ice, and water resources development. (See W70-03095). (Knapp-USGS)
W70-03096

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, OCEAN SPRINGS-DEER ISLAND QUADRANGLES, MISSISSIPPI,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 04A.
W70-03097

FLOODS OF APRIL 28, 1966, IN THE NORTHERN PART OF DALLAS, TEXAS,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 04A.
W70-03098

FLOODS OF JUNE 1965 IN SOUTH PLATTE RIVER BASIN, COLORADO,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 04A.
W70-03100

FLOODS IN NEW YORK-1968,
Geological Survey, Albany, N.Y.
F. Luman Robison.
New York Water Resources Commission Report of Investigation RI-9, 1969. 30 p, 6 fig, 1 tab.

Descriptors: *Floods, *New York, *Flood damage, Discharge (Water), Stage-discharge relations, Data collections, Hydrologic data, Streamflow, Flood plains, Floodwater, Rainfall, Precipitation (Atmospheric).
Identifiers: Flood data.

Information is presented on floods reported in New York State during the calendar year 1968. The information was obtained from newspaper clippings, from the U.S. Weather Bureau publications 'Storm Data and Unusual Weather Phenomena, 1968' and 'Daily Precipitation Records,' from records of the U.S. Geological Survey, and from reports of the U.S. Army Corps of Engineers. Floods were reported someplace in New York in every month of 1968, but at most sites the resulting damage was not great. The most serious flood event of the year occurred in the southeastern part of the State at the

end of May. Heavy rain began about 10 pm on May 28 and ended before noon the next day. The maximum measurement of 5.54 inches was recorded at Dobbs Ferry, Westchester County. At Central Park in New York City a reading of 4.88 inches broke a 60-yr record for 24-hr rainfall. Peak discharges for many streams in the flood area are tabulated with corresponding maximum peaks of record prior to May 29 for comparison. (Knapp-USGS)
W70-03103

FLOODS OF AUGUST 1967 IN MARYLAND AND DELAWARE,
Geological Survey, Towson, Md.
D. H. Carpenter, and R. H. Simmons.
Geological Survey Open-file Report, 1969. 98 p, 36 fig, 1 tab.

Descriptors: *Floods, *Maryland, *Delaware, *Rainfall, *Historic flood, Data collections, Gaging stations, Hydrologic data, Discharge (Water), Flood damage, Erosion, Rainfall-runoff relationships, Stage discharge relations, Precipitation intensity.
Identifiers: Flood records, Crest-gage stations.

Intense rainfall associated with severe thunderstorm activity during several periods in August 1967 caused considerable flooding throughout much of Maryland and Delaware. Precipitation intensities up to 2-1/2 inches in 1 hour and totals up to 9 inches in 6 hours were experienced. Total recorded rainfall for the month ranged from less than 5 inches in western Maryland to 19 inches on the Eastern Shore, in the wettest month since August 1955. Extensive damage was done. Numerous dams, bridges, culverts, and portions of roadways were washed out. Total damage was estimated to be more than $1,700,000. Discharge data are presented for 61 regular gaging stations, 30 crest-gage stations, and 3 miscellaneous sites. Maximum peaks of record occurred at 20 of the regular gaging stations. The maximum peak discharge rate recorded was 1,190 cfs per sq mi. (Knapp-USGS)
W70-03104

ATTEMPT AT AN ESTIMATE OF BANK REGULATION OF STREAMFLOW IN THE BASIN OF THE SEVERSKIY DONETS RIVER,
V. P. Yunitsyna.
Transl from GGI, Sbornik Rabot po Gidrologii, No 8, p 122-130, 1968. Soviet Hydrology: Selected Papers, No 4, p 393-400, 1968. 3 fig, 2 tab, 10 ref.

Descriptors: *Bank storage, *River flow, Rivers, Channels, Water level fluctuations, Groundwater recharge, Surface waters, Soil moisture, Statistical methods, Equations, Surface-groundwater relationships.
Identifiers: *USSR, *Severskiy Donets River.

The quantitative aspects of the bank regulation process are important in understanding relationships between surface and groundwater. Computations were made for reaches of the main Donets River and for the other tributaries of the drainage system, using aerial photographs, hydrographic, hydrometric, and hydrogeologic data. The data obtained were: (1) daily water volumes in the channel and banks; (2) variation in bank volumes in time and along the river; (3) daily volumes of inflow to the channel network. For example, during the 1963 flood when the river level rose 4 m, the amount of water accumulated in the banks was 46 million cu m. By contrast, only 4.75 million cu m seeped into the ground when the river level rose only 2.3 m. (Carstea-USGS)
W70-03106

HYDROMORPHOLOGICAL PRINCIPLES OF COMPUTATIONS OF FREE MEANDERING: 1. SIGNS AND INDEXES OF FREE MEANDERING,
For primary bibliographic entry see Field 02J.
W70-03107

SOME PROBLEMS CONCERNING THE THERMAL REGIME OF RIVERS IN THE ARAKS BASIN,
For primary bibliographic entry see Field 05A.
W70-03112

HYDRAULIC COMPUTATION OF FLOOD-PLAIN CHANNELS,
For primary bibliographic entry see Field 08B.
W70-03113

CONVERSION OF ANNUAL STREAMFLOW TO A LONG PERIOD,
A. V. Rozhdestvenskiy.
Transl from GGI, Sbornik Rabot po Gidrologii, No 8, p 3-13, 1968. Soviet Hydrology: Selected Papers, No 4, p 365-374, 1968. 3 fig, 3 tab, 4 ref.

Descriptors: *Data collections, *Steamflow, *Simulation analysis, Equations, Flow, Statistical methods, Monte Carlo method, Rivers, Time series analysis, Hydrologic properties.
Identifiers: *USSR, Neva River, Tikhvinka River.

Annual streamflow is converted to a long period by simulating a short-period hydrologic series for a period for which there are observations at an analogous point. The proposed method can be used to convert series of not less than 15-20 years to a longer period. The method consists of the following steps: (1) Computation of the dynamic normal flow from a given short observation series and from an analogous series; (2) construction of graphs of the relationship between the dynamic flow normals over a common observation period for points with short and long records; and (3) random, uncorrelated fluctuations with respect to the dynamic flow normal are correlated by the Monte Carlo method. These steps are discussed and illustrated with data from the Neva River at Petrokrepost and the Tikhuinka River at Gorelukhi. (Carstea-USGS)
W70-03115

WATERS OF 'MIDDLE ASIA' (RUSSIAN),
Akademiya Nauk SSSR, Moscow. Institut Geografii.
N. T. Kuznetsov.
Moscow, Izdatel'stvo 'Nauka', 1968. 272 p, 56 fig, 23 tab, 288 ref.

Descriptors: *Water resources, *Surface waters, Water balance, Water demand, Water chemistry, Water supply, Climatic data, Frost, Groundwater, Glaciers, Lakes, River systems, Bibliographies.
Identifiers: Outer and Inner Mongolia, North China, Middle Asia (USSR).

The hydrology of the Mongolian Peoples' Republic, Inner Mongolia, and several dry provinces in China, in total area over 4,200,000 sq km, is described. The hydrological and chemical characteristics of the rivers, lakes, and water reservoirs were identified and expressed in numerous tables and charts. The water sources of 'Middle Asia' are the snow-melt waters and summer precipitation. In general the formation runoff on 'Middle Asia' takes place higher absolute altitudes than that of Central Asia. The rivers of 'Middle Asia' have later snow floods than those of Central Asia. Topics discussed include: (1) the effect of geographical conditions on the life present in rivers, lakes, and marsh lands; (2) development of rivers and lakes in the Quaternary period; (3) rivers; (4) lakes and marsh lands; and (5) the paths and possibilities of the development of water economy. (Gabriel-USGS)
W70-03117

FLOOD-PLAIN DRAINAGE AND FLOOD DISCHARGES OF THE UKRAINIAN SMALL RIVERS (RUSSIAN),
Ukrainian Scientific Research Inst. of Hydroengineering and Land Reclamation (USSR).
G. P. Kubyshkin.
Gidrotekhnika i Melioratsiya, No 8, p 55-59, Aug 1969. 2 fig, 2 tab, 6 ref.

Descriptors: *Drainage, *Flood plains, *Floods, *Rivers, *Floodwater, *Discharge (Water), Climates, Reclamation, Peat, Bogs, Snowmelt, Runoff, Soils, Agricultural engineering, Statistical models, Cost analysis.
Identifiers: *USSR, Flood plain drainage, Ukrainian rivers.

The effect of flood-plain drainage was experimentally investigated by comparing the maximum and minimum discharges of small Ukrainian rivers before and after the introduction of a reclamation drainage system. Analysis of the data collected during the 40-year period shows that the reclamation drainage of flood plains leads to a considerable decrease of runoff magnitudes of both low and high frequencies. This decrease in flood intensity permits the construction of river dams of smaller discharge capacity. (Gabriel-USGS)
W70-03120

LINEAR ROUTING IN UNIFORM OPEN CHANNELS,
University Coll., Cork (Ireland). Dept. of Civil Engineering.
J. C. I. Dooge, and B. M. Harley.
Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 8, p 57-63, 1967. 7 p, 4 fig, 7 ref.

Descriptors: *Rainfall-runoff relationships, *Routing, *Streamflow forecasting, *Open channel flow, *Mathematical models, Linear programming, Computers, Digital computers, Flood forecasting, Simulation analysis, Flood routing.
Identifiers: Linear routing (Open channel flow).

A general linear solution to the flood routing problem is obtained by solving a linearized equation of motion for a semi-infinite uniform open channel subject to a delta-function inflow at the upstream end. This general linear solution is used to compare the accuracy of the more important special linear procedures used in applied hydrology for flood routing. The effect of varying the reference discharge which is used as the basis of the linearization is also examined. (Knapp-USGS)
W70-03126

EFFECT OF BASIN MORPHOLOGY ON RESPONSE TO FLOOD FLOWS,
Oklahoma State Univ., Stillwater. Bioengineering Labs.; and Oklahoma State Univ., Stillwater. Water Resources Research Inst.
For primary bibliographic entry see Field 07C.
W70-03127

USE OF LOG-TRANSFORMATION TO THE ANALYTICAL REPRESENTATION OF RIVER RUNOFF,
Hokkaido Univ., Sapporo (Japan). Dept. of Civil Engineering.
Tsutomu Kishi.
Proceedings International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 4, p 25-30, 1967. 6 p, 2 fig.

Descriptors: *Rainfall-runoff relationships, *Streamflow forecasting, *Statistical methods, *Unit hydrographs, *Hydrograph analysis, Routing, Runoff forecasting, Flood forecasting.
Identifiers: Runoff analysis, Tokoro River (Japan).

The nonlinear character of river runoff has been pointed out by many investigators. Unit graphs derived from different storms for a river basin are not identical, in general, except for some favorable cases in which various integrating influences of the basin smooth out the nonlinearity. A theory is developed to give mathematical expressions to variable distribution graphs or unit graphs. Asymmetric distribution graphs can be transformed to the normal distribution curve by using a log-transformation. The inherent variation of the runoff character is described by assigning a particular set of values for the parameters of a transformation

relationship. Several types of transformation relationships are investigated. Application of the theory to the analysis of runoff for the Tokoro River, Hokkaido, Japan is given as an illustrative example. (Knapp-USGS)
W70-03130

RUNOFF ANALYSIS AND WATER-BALANCE ANALYSIS BY A SERIES STORAGE TYPE MODEL,
National Research Center for Disaster Prevention, Tokyo (Japan).
For primary bibliographic entry see Field 02A.
W70-03131

ANALYTICAL SIMULATION OF WATERSHED HYDROGRAPHS FROM RAINFALL,
Agricultural Research Service, Beltsville, Md. Hydrograph Lab.
For primary bibliographic entry see Field 02A.
W70-03132

A DISTRIBUTED LINEAR MODEL FOR PEAK CATCHMENT DISCHARGE,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Land Research and Regional Survey.
For primary bibliographic entry see Field 02A.
W70-03133

A MATHEMATICAL WATERSHED ROUTING MODEL,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 02A.
W70-03134

A CONTRIBUTION TO ANALOGUE AND PHYSICAL MODELING OF SURFACE RUNOFF PROCESS IN SMALL BASINS,
For primary bibliographic entry see Field 07C.
W70-03135

2F. Groundwater

QUEBRADA DE LOS CEDROS, SOUTHWESTERN PUERTO RICO, AND ITS BEARING ON SOME ASPECTS OF KARST DEVELOPMENT,
Puerto Rico Univ., Mayaguez. Dept. of Geology.
Mounir T. Moussa.
Journal of Geology, Vol 77, No 6, p 714-720, Nov 1969. 7 p, 2 fig, 4 ref.

Descriptors: *Karst, *Structural geology, *Drainage patterns (Geologic), *Puerto Rico, Limestones, Caves, Geomorphology, Erosion, Permeability, Porous media, Fractures (Geology), Joints (Geology).
Identifiers: *Karst development, *Subterranean stream piracy.

The gorge of Quebrada de los Cedros (a tributary of Rio Macana in southwestern Puerto Rico) is a deroofed portion of a complex cavern system through which part of the drainage of Rio Tallaboa was diverted by a process of subterranean stream piracy. The karst features in Quebrada de los Cedros and in other parts of the region indicate that the absence of extensive karst development in the mid-Tertiary limestones in southwestern Puerto Rico is probably due to their lack of mass permeability rather than to insufficient rainfall. The direction of the underground flow in the upper part of the quebrada is against the direction of the dip of the beds, which indicates that the structural control is not critically important in the development of subterranean passageways. Water will move along any plane, whether structurally controlled or not, as long as it has the opportunity to be drained at a lower level under the force of gravity. (Knapp-USGS)
W70-02852

LAND SUBSIDENCE DUE TO WITHDRAWAL OF FLUIDS,
Geological Survey, Sacramento, Calif.; and Geological Survey, Washington, D.C.
J. F. Poland, and G. H. Davis.
Geological Society of America, Inc Reviews in Engineering Geology II, p 187-269, 1969. 83 p, 49 fig, 7 plate, 2 tab, 119 ref, index.

Descriptors: *Subsidence, *Withdrawal, *Groundwater, Settlement (Structural), Water wells, Oil wells, Compaction, Pore pressure, Elasticity (Mechanical), Artificial recharge, Clays.
Identifiers: Subsidence-fluid withdrawal relationships.

Land-surface subsidence due to the withdrawal of fluids by man has become relatively common in the United States since 1940 and has been described at several other places throughout the world. Known examples of appreciable land subsidence are reviewed. Those related to exploitation of oil and gas fields include Goose Creek, Texas; Wilmington, California; Lake Maracaibo, Venezuela; Niigata, Japan; and the Po Delta in Italy. The areas related to groundwater withdrawal include areas in Japan; Mexico City, Mexico; and Texas, Arizona, Nevada, and California. The areas of greatest extent and maximum subsidence are in California. The principles involved in the compaction of sediments and of aquifer systems are examined briefly. The amount of compaction that a confined aquifer system will experience is a function of compressibility. Other factors that influence compaction (and, in part, compressibility) include particle size and shape, clay mineralogy, geochemistry of pore water in the clayey beds and of the water in contiguous aquifers, and secondary compression. Subsidence problems are alleviated by cessation of withdrawal and increase or restoration of reservoir pressure. The greatest control measures are taken at Wilmington, California, where subsidence of 27 feet is nearly stopped; in addition, significant rebound has occurred. (Knapp-USGS)
W70-02861

NUCLEAR BLAST RESISTANT WATER WELLS,
Naval Civil Engineering Lab., Port Hueneme, Calif.
For primary bibliographic entry see Field 08A.
W70-02865

GROUNDWATER INVESTIGATION, MOUNT KOBAU, BRITISH COLUMBIA,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
E. C. Halstead.
Inland Waters Branch Technical Bulletin No 11, Department of Energy, Mines and Resources, 1969. 14 p, 14 fig, 3 tab, 2 ref.

Descriptors: *Water supply, *Groundwater, *Hydrogeology, *Hydrologic budget, Water wells, Recharge, Groundwater movement, Discharge (Water), Aquifers, Streamflow, Snowmelt, Water levels, Water storage, Reservoirs.
Identifiers: *Canada, Mt. Kobau (British Columbia), Aquifer testing.

The groundwater budget of Mt. Kobau, British Columbia was studied by drilling 5 test wells and testing a production well drilled for the water supply of a proposed Canadian National Observatory site. The flow of Testalinden Creek is maintained by the storage, movement and discharge of groundwater in fractured bedrock which outcrops at the summit of Mount Kobau. The groundwater is recharged annually by snowmelt. The pump test was continuous for 47 hours at a rate of 7.5 imperial gpm with a drawdown of 52.2 feet. During the 1967 calendar year, total precipitation was 20.91 inches, of which 3.61 inches fell as rain and the remaining 17.30 inches, as snow. The groundwater recharge into the fractured bedrock depends upon the volume of snowmelt. The thin overburden, which functions as a permeable mantle beneath the snow cover, retains a significant volume of meltwater long enough to enable recharge to continue well beyond the peak of the melting season. Groundwater recharge at the summit is sufficient to sustain a minimum base flow in Testalinden Creek of 0.2 imperial gpm. (Knapp-USGS)
W70-02867

WATER AND RELATED LAND RESOURCES, CENTRAL LAHONTAN BASIN - WALKER RIVER SUBBASIN NEVADA-CALIFORNIA.
Nevada River Basin Survey, Carson City.
For primary bibliographic entry see Field 02E.
W70-02868

OBSERVATIONS ON WATER CONTENT CHANGES IN STRATIFIED SEDIMENTS DURING PIT RECHARGE,
Arizona Water Resources Research Center, Tucson.
For primary bibliographic entry see Field 04B.
W70-02887

A METHOD OF ANALYZING TRANSIENT FLUID IN MULTILAYERED AQUIFERS,
Pahlavi Univ., Shiraz (Iran); California Univ., Berkeley.
Iraj Javandel, and Paul A. Witherspoon.
Water Resour Res, Vol 5, No 4, p 856-869, Aug 1969. 14 p, 10 fig, 13 ref.

Descriptors: Transients, *Unsteady flow, *Aquifers, Methodology, Theis equation, Fluid flow, *Groundwater flow, Anisotrophy, Permeability, Drawdown, Numerical analysis, Groundwater, Pumping, Analysis.
Identifiers: *Transient flow, Finite element method, Two-part aquifers, Boundary conditions.

A new approach to transient fluid flow in multilayered aquifers of anisoptropic systems was developed using the finite element method. This is a numeric technique in which an initial boundary value problem is converted to a variational problem and applied to a discrete system of elements. The method was used to investigate potential distributions in multilayered aquifers of finite radial extent being pumped at constant rate using completely penetrating wells. An analysis of 2-layer systems with permeability contrasts of up to 100:1 indicates that at early time the drawdown behavior can vary significantly from the Theis solution, depending on where observations are made. As time increases, results converge on the Theis solution, regardless of the permeability contrast. A 13-layer aquifer containing either isotropic or anisotropic layers was also examined. Results are in general agreement with the behavior for 2-layer systems. (USBR)
W70-02943

THE CONVOLUTION RELATION AS APPLIED TO ESTIMATING RECHARGE FROM AN EPHEMERAL STREAM,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
Allen F. Moench, and Chester C. Kisiel.
Available from the Clearinghouse as PB-189 083, $3.00 in paper copy, $0.65 in microfiche. Paper presented at 50th Annual Meeting of American Geophysical Union, Wash, DC, Apr 21-25, 1969. 20 p. OWRR Grants No B-007-ARIZ, and A-010 WRRC-ARIZ.

Descriptors: *Surface-groundwater relationships, *Model studies, *Mathematical models, Induced infiltration, Observation wells, Equations, Groundwater movement, Groundwater recharge, Aquifer characteristics, Channel morphology, Recharge, Water yield, Water levels, Ephemeral streams, Hydrogeology.
Identifiers: Hydrologic model studies.

A linear model is presented which enables one to estimate recharge from a source of finite width and infinite length given water level measurements in an observation well. The method requires solution

of the inverse problem of finding the system input given the system output (water level measurements) and the system impulse response function. The impulse response function is derived from the linear equations of groundwater motion for the particular geometry of this study. The discrete form of the convolution integral is rearranged so as to obtain the system input (timewise variation of recharge) by the method of synthetic division. Aquifer constants are estimated independently. Total recharge is obtained by integrating the system input over the appropriate time period. For the particular event and location of this study, results are in good agreement with an independent estimate of recharge. (Carstea-USGS)
W70-03064

ELECTRICAL RESISTIVITY SURVEY IN THE PIEDMONT AREA, ALABAMA,
Alabama Geological Survey, University; and Auburn Univ., Ala. Water Resources Research Inst.
W. Leon Scarbrough, Thomas J. Joiner, and James C. Warman.
Geological Survey of Alabama Circular 57, 1969. 20 p, 11 fig, 3 plate, 34 ref. OWRR Proj No A-009-ALA.

Descriptors: *Electrical studies, *Resistivity, *Subsurface mapping, *Groundwater, *Alabama, Weathering, Geology, Surveys, Aquifers, Geophysics, Structural geology, Faults (Geology), Fissures (Geology), Hydrogeology.
Identifiers: Groundwater prospecting.

Electrical resistivity investigations were made in the Piedmont of Alabama by assuming that weathered or solutionally enlarged water-bearing openings along fractures in the bedrock would be more conductive than solid unaltered bedrock and would be indicated as conductive anomalies. A semi-empirical method using the bedrock surface as a datum plane was used. Approximately 12 square miles in and around the town of Heflin and 2 square miles about 10 miles southeast of Heflin were included in this study. When electrical resistivity methods are correlated with other geophysical data and with geologic, hydrologic and topographic data they are valuable tools for solving groundwater problems. Resistivity anomalies were interpreted to indicate sand and gravel deposits in alluvium, and deeply weathered fracture zones in saprolite and bedrock, caused by localized occurrence and movement of groundwater. Lateral changes in the lithology of alluvium and saprolite have also been interpreted. (Knapp-USGS)
W70-03067

DATA FROM TEST DRILLING FOR PUBLIC WATER SUPPLIES IN LOUISIANA - JULY 1966 THROUGH JUNE 1967,
Geological Survey, Baton Rouge, La. Water Resources Div.
J. L. Snider.
Geol Surv Open-file Rep, 1969. 133 p, 1 fig, 4 ref.

Descriptors: *Data collections, *Hydrologic data, *Water wells, *Louisiana, Aquifers, Particle size, Sands, Water quality, Water supply, Municipal water.
Identifiers: Test holes.

Geologic and hydrologic data were obtained from test holes and test wells drilled for the Louisiana Department of Public Works to aid communities and State facilities seeking sources of groundwater. The data are from 72 test holes, 74 test wells, and 3 supply wells drilled at 44 communities or State facilities between July 1, 1966, and June 30, 1967. Data given include physical data on test holes, physical and construction data on test and supply wells, grain-size and sand-thickness and depth tables, and chemical analyses of water samples from test and production wells. (Knapp-USGS)
W70-03080

THEORETICAL ANALYSIS OF REGIONAL GROUNDWATER FLOW,
California Univ., Berkeley.
R. A. Freeze.
Inland Waters Branch Scientific Series No 3, Department of Energy, Mines and Resources, Ottawa, Canada, 1969. 200 p, 31 fig, 63 ref, 2 append.

Descriptors: *Mathematical models, *Computer programs, *Groundwater movement, Mathematical studies, Computer models, Flow nets, Water levels, Water level fluctuations, Water yield, Safe yield, Recharge, Discharge (Water), Mapping, Water table, Model studies, Groundwater basins.
Identifiers: *Canada, Groundwater basin analysis.

A mathematical model representing steady-state regional groundwater flow in a three-dimensional, nonhomogeneous, anisotropic groundwater basin is developed. Two independent methods of solution are presented: the analytical separation of variables technique is used to solve the two-dimensional, 3-layer case; the numerical finite-difference approach is used to solve the general case. The numerical method is more versatile, mathematically simpler, and well-suited to computer-oriented methods of data storage. Computer programs are presented for both methods; the output consists of plotted potential nets from which flow patterns can be constructed. The potential patterns for over 70 hypothetical cases are presented to illustrate the qualitative and quantitative control exerted on the flow system by: (a) the 'depth/lateral extent' ratio of the groundwater basin; (b) the configuration of the water table; and (c) the geologic configuration and resultant permeability contrasts. The concept of 'natural basin yield' is introduced. The mathematical model approach using numerical solutions and the digital computer can be used both as a reconnaissance tool preceding field investigation and as an interpretive tool following the field program. The results of mathematical model analyses on two actual groundwater basins in the Canadian prairies are presented. (Knapp-USGS)
W70-03084

GROUNDWATER DEVELOPMENT IN IDAHO - 1968,
Idaho Dept. of Reclamation, Boise.
Dale R. Ralston.
Idaho Department of Reclamation Water Information Bulletin No 10, May 1969. 24 p, 14 fig, 3 tab.

Descriptors: *Water resources development, *Idaho, *Groundwater, Water wells, Aquifers, Water supply, Water rights.
Identifiers: Groundwater development (Idaho).

Groundwater development in Idaho increased in activity in 1968 with 55% more applications approved to appropriate groundwater and 70% more wells reported drilled than in 1967. A large portion of the increase in filings was the result of small irrigation or domestic filings. The Boise River area was the center of groundwater development in the state, in both applications approved and wells reported drilled. The south Snake Plain areas, Aberdeen-Springfield, Minidoka-Jerome, and Wood River, are also important areas with respect to the ultimate groundwater development of the state. These areas included about one-third of the total quantity appropriated in 1968 and are located on the very productive Snake Plain aquifer. Agricultural growth will be influenced by decisions concerning desert land entries and by the general availability of surface water. (Knapp-USGS)
W70-03094

WATER, EARTH AND MAN: 3. HUMAN USE OF GROUNDWATER,
Geological Survey, Washington, D.C.
R. L. Nace.
London, England, Methuen and Company, Limited, p 285-294, 1969. 10 p, 3 fig, 15 ref.

Descriptors: *Water utilization, *Water sources, *Groundwater, *Water resources development, Surveys, Reviews, History, Saline water intrusion, Water pollution.
Identifiers: Groundwater utilization.

Groundwater use is briefly outlined in a chapter of a broad survey of Man's relation to water resources. The topics reviewed include groundwater sources, the groundwater part of the hydrologic cycle, climatic effects, water management, artificial recharge, pollution, and saline water intrusion. (See W70-03096). (Knapp-USGS)
W70-03095

HYDROGEOLOGY AND GROUNDWATER RESOURCES OF THE GRAVELBOURG AQUIFER, SASKATCHEWAN,
California Univ., Berkeley.
R. Allan Freeze.
Inland Waters Branch Scientific Series No 6, Department of Energy, Mines and Resources, Ottawa, Canada, 1969. 60 p, 31 fig, 14 tab, 38 ref, 2 append.

Descriptors: *Hydrogeology, *Aquifers, *Glacial drift, *Gravels, *Sands, Permeability, Transmissivity, Recharge, Discharge (Water), Groundwater movement, Storage coefficient, Water quality, Water chemistry, Water utilization.
Identifiers: *Canada, *Gravelbourg (Saskatchewan).

The groundwater flow pattern in the Gravelbourg aquifer, Saskatchewan was delineated by a number of hydrogeological mapping techniques. Quantitative characteristics of the aquifer were determined from one pumping test. The aquifer consists of stratified Pleistocene glacial sand together with associated thin outwash, overlain by less-permeable Pleistocene sediments, and is underlain by poorly permeable shale. The bedrock surface in the Gravelbourg area is a broad valley opening to the northeast, which controls the extent of the stratified drift. Flow through the aquifer is essentially horizontal, with some discharge occurring through the overlying sediments. The major discharge is into Old Wives Lake. Recharge occurs through the glacial till and the silty clay phase of the stratified drift from the adjacent morainal upland areas and from the upstream part of the overlying plain. The water from the aquifer is a sodium sulfate type, with 2500 to 5500 ppm dissolved solids, barely potable without treatment, and unsuitable for irrigation. The maximum transmissibility of the aquifer is 5200 Imperial gpd per ft and the coefficient of storage is 0.00092. The horizontal permeability is 104 Imperial gal/day/sq ft. The vertical permeability of the glacial till is in the order of 3-20 gal/day/sq ft, as determined by tritium dating and pump testing evidence. The safe yield of the aquifer is 280 acre-ft per yr; present utilization is 56 acre-ft per yr. (Knapp-USGS)
W70-03105

ACCURACY OF WELL DISCHARGE COMPUTATIONS FROM CURVES OF THE DISCHARGE AS A FUNCTION OF THE DROP IN WATER LEVEL (TAKING THE DZHEZKAZGAN REGION AS AN EXAMPLE),
For primary bibliographic entry see Field 04B.
W70-03114

ON THE TRANSFER FUNCTION OF LIMITED POROUS MEDIA,
Toulouse Univ. (France). Institut de Mecanique des Fluides.
Claude Thirriot, and Jean Pierre Villeneuve.
Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 28, p 211-217, 1967. 7 p, 5 fig.

Descriptors: *Unsteady flow, *Porous media, *Model studies, *Hydraulic models, *Surface-groundwater relationships, Groundwater movement, Induced infiltration, Infiltration, Discharge (Water), Water levels, Water level fluctuations.
Identifiers: Boussinesq equation.

Unsteady periodical flow is studied in porous media lying between two tanks representing lakes, rivers, or channels. One tank level varies sinusoidally. This problem is examined both theoretically, using two linearizing processes of Boussinesq's equation, and by experimental devices including a glass-marble model. Curve boards showing fluctuation amplitude and phase in each medium point show the influence of frequency and ratio of entrance amplitude to mean water height on the upstream boundary. (Lang-USGS)
W70-03136

CONTRIBUTIONS ON THE STATUS OF ARID-LANDS RESEARCH: GROUNDWATER IN AUSTRALIA,
Arizona Univ., Tucson; and Army Natick Labs., Mass. Earth Sciences Div.
For primary bibliographic entry see Field 04B.
W70-03229

2G. Water in Soils

SALINITY TOLERANCES OF CERTAIN TROPICAL SOILS AND RELATIONSHIPS BETWEEN SODIUM ION ACTIVITIES AND SOIL PHYSICAL PROPERTIES,
Hawaii Univ., Honolulu.
For primary bibliographic entry see Field 03C.
W70-02848

EVALUATION OF NUCLEAR METHODS OF DETERMINING SURFACE IN SITU SOIL WATER CONTENT AND DENSITY,
Corps of Engineers, Vicksburg, Miss. Waterways Experiment Station.
For primary bibliographic entry see Field 07B.
W70-02876

SOIL-WATER MOVEMENT IN RELATION TO MEASURED PHYSICAL PROPERTIES,
California Univ., Davis. Dept. of Water Science and Engineering.
D. R. Nielsen.
Report available from Clearinghouse as AD-688 177, for $3.00 in paper copy, $0.65 in microfiche. US Army Electronics Command Technical Report Ecom-0034-F, Atmospheric Sciences Lab, July 1968. 77 p, 38 fig, 9 tab, 81 ref. Grant DAAB07-67-C-0034 Proj No IVO-14501-B53A-08.

Descriptors: *Soil water movement, *Soil physical properties, *Diffusivity, *Evapotranspiration, Soil moisture, Soil water, Percolation, Diffusion, Thermodynamics, Heat transfer, Mass transfer, Water balance, Evaporation, Infiltration, Unsaturated flow.
Identifiers: Soil water diffusivity.

A laboratory method was developed for calculating isothermal soil water diffusivity values for soils at 5 to 15 volume percent water. The redistribution of soil water within columns of Columbia fine sandy loam in response to imposed temperature gradients was analyzed. Transient water content distribution and soil temperature were recorded. Values of net water flux were examined in light of Fick's law, a diffusion theory proposed by Philip and de Vries, and an irreversible thermodynamic theory used by Taylor and Cary. Fick's law consistently underpredicted the observed water fluxes while the Philip-de Vries theory yielded acceptable values. Predictions of water flux based upon the Taylor-Cary theory were not acceptable. An intensive field investigation was conducted to measure and predict the soil temperature behavior during and following infiltration. A simplified mathematical model was used to predict temperature changes from the soil surface to a depth of 2 meters. The quantities of heat added by the infiltrating water were compared with the terms in the energy balance equation for that soil surface. Water balance measured at the soil surface allowed an estimate of the water moving past the root zone of an actively transpiring crop. (Knapp-USGS)
W70-02892

CLAY MINERAL STABILITY AND WATER COMPOSITION,
Washington State Univ., Pullman.
For primary bibliographic entry see Field 05A.
W70-03026

PREDICTION OF FLOW RESISTANCE IN FURROWS FROM SOIL ROUGHNESS,
Colorado Agricultural Experiment Station, Ft. Collins.
For primary bibliographic entry see Field 03F.
W70-03221

SOIL MOISTURE ON NATIVE GRAZING LANDS IN THE SEMIARID NORTHERN PLAINS OF USA,
Agricultural Research Service; and Montana Agricultural Experiment Station, Bozeman.
For primary bibliographic entry see Field 03F.
W70-03222

RECENT ADVANCEMENTS IN THE USE OF STANDARD CLIMATIC DATA FOR ESTIMATING SOIL MOISTURE,
Department of Agriculture, Ottawa (Ontario). Plant Research Inst.
W. Baier.
Annals of Arid Zone, Vol 6, No 1, p 1-21, Mar 1967. 22 p, 5 tab, 3 fig, 47 ref.

Descriptors: *Arid lands, *Soil moisture, *Soil-water-plant relationships, *Climatic data, *Water balance, Soils, Wheat, Droughts, Micrometeorology, Evapotranspiration, Computer models, Statistical methods, Moisture availability, Crop response, Evaporation, Electrical resistance.
Identifiers: *Canada, Electrical resistance blocks, Potential evaporation, Parameters.

There have been many studies of plant response to microclimatic parameters, but many of the parameters are not generally available and are difficult to measure. This paper reviews advances in technique to estimate soil moisture and crop response from standard climatic data which is widely available. This technique is of particular importance in arid and semiarid zones, where soil moisture is often the limiting factor. The author also discusses results of his statistical investigation of methods for estimating soil moisture and evaporation from standard climatic data. A versatile soil moisture budget (VB) technique is discussed which accounts for most of the requirements for earlier and generally more difficult meteorological budgeting methods. Using coefficients developed for several soil zones, correlation coefficients of .90 were obtained between soil moisture estimates using VB and soil moisture block readings. Daily soil moisture under wheat on a zone-by-zone basis was estimated by VB method and checked closely with measured soil moisture. VB generally provided good estimates even at different locations. Some discrepancies were noted in estimates for lower soil zones on days of peak water loss. This suggests that during drought plants are able to utilize available water in lower zones more efficiently than they do in periods of uniform moisture distribution. (Crouse-Arizona)
W70-03233

2H. Lakes

MAGADIITE FROM ALKALI LAKE, OREGON,
Air Force Cambridge Research Center, Bedford, Mass.; Geological Survey, Washington, D.C.; and Air Force Academy, United States Air Force Academy, Colo.
Thomas P. Rooney, Blair F. Jones, and James T. Neal.
The American Mineralogist, Vol 54, p 1034-1043, July-Aug 1969. 10 p, 4 fig, 2 tab, 12 ref.

Descriptors: *Water chemistry, *Chemical precipitation, *Sodium compounds, *Silicates, *Playas, *Oregon, Mud, Geology, Mineralogy, Aqueous solutions, Brines, Mud flats.
Identifiers: Magadiite, Alkali Lake (Ore).

Magadiite (a hydrous sodium silicate) has been identified in veins cutting playa sediments and in muds associated with alkali salts and brines at Alkali Lake playa, Oregon. Magadiite has apparently precipitated directly from solution, perhaps as a result of pH changes on dilution by runoff. The magadiite veins may be related to syneresis cracking in very fine-grained playa sediments derived from acid volcanics. (Knapp-USGS)
W70-02856

PRELIMINARY OBSERVATIONS UPON THE FERTILIZATION OF CRECY LAKE, NEW BRUNSWICK,
Atlantic Biological Station, St. Andrews (New Brunswick).
M. W. Smith.
Transactions of the American Fisheries Society, Vol 75, p 165-174, 1945. 1 fig, 1 tab, 14 ref.

Descriptors: *Fertilization, *Nitrogen, *Phosphorus, *Potassium, Hydrogen ion concentration, Fish, Lakes, Productivity, Brook trout, Shallow water, Sampling.
Identifiers: New Brunswick, Nova Scotia, Infertile waters, Enrichment, Ammonium phosphate, Potassium chloride, Bottom fauna, Microcrustacea, Crecy Lake (N B Canada), Salvelinus fontinalis, Anabaena blooms.

Addition of one ton of mono-ammonium phosphate and 500 pounds of potassium chloride to infertile 20-hectare lake increased the planktonic biomass and benthic organisms, largely Hyalella. The development of a heavy bloom of Anabaena appeared to have a deleterious effect on microcrustaceans. The soluble fraction of the introduced phosphate was rapidly decreased by biofixation from about 0.4 parts per million to 0.03 parts per million. (Wilde-Wisconsin)
W70-02974

COMPOSITION AND HORIZONTAL DISTRIBUTION OF CRUSTACEAN PLANKTON IN LAKE ONTARIO,
Fisheries Research Board of Canada, Winnipeg (Manitoba). Freshwater Inst.
K. Patalas.
Journal Fisheries Research Board of Canada, Vol 26, No 8, p 2135-2164, 1969. 23 fig, 1 tab, 23 ref.

Descriptors: *Distribution patterns, *Lake Ontario, *Plankton, Daphnia, Sampling, Crustaceans, Copepods.
Identifiers: *Horizontal distribution, *Crustacean plankton, Bosmina, Cyclops, Ceriodaphnia, Tropocyclops, Vertical distribution, Sampling stations, Cladocera.

Distribution of zooplankton was ascertained through collections from June-October 1967 as part of an effort to characterize the biological communities of the Great Lakes relative to natural and cultural eutrophication processes. Eleven species of copepods and cladocerans were found; most abundant forms being species of Cyclops, Daphnia, Bosmina, Tropocyclops, and Ceriodaphnia. Bosmina longirostris and Cyclops bicuspidatus were most abundant cladocerans and copepods, respectively, in summer plankton. Most species appeared in June-July at eastern end of lake, zones of abundance later expanding westward. In September, some species (Bosmina, Ceriodaphnia) occurred mainly in western end, disappearing from the east. Others (Daphnia, Cyclops) were distributed over entire lake, inclined to concentrate in offshore regions. In October, most species had decreased in western end with a slight increase in abundance in the eastern end, tending to a more uniform lakewide distribution. Total plankton concentration was highly correlated (coefficient of correlation, $r = 0.80$, degrees of freedom approximately 13) with heat content (kilocalories/square centimeter) of water. Thermal structure of lake is wind-generated. Graphical data include seasonal distribution maps of dominant zooplankters, and

detailed study of effects of Toronto Harbor on localized zooplankton populations. (Voigtlander-Wisconsin)
W70-02975

WATER QUALITY STUDIES ON THE GREAT LAKES BASED ON CARBON FOURTEEN MEASUREMENTS ON PRIMARY PRODUCTIVITY,
Minnesota Univ., Minneapolis.
William G. Parkos, Theodore A. Olson, and Theron O. Odlaug.
Water Resources Research Center, Minnesota Univ Graduate School, Minneapolis, WRRC Bulletin 17, 1969. 121 p, 23 fig, 25 tab, 70 ref, 10 plates, appendix A, B, C, D, E, F. OWRR Project A 011-MINN.

Descriptors: *Primary productivity, Surface waters, Productivity, Phytoplankton, Great Lakes, Lake Superior, Lake Michigan, Lake Huron, Lake Erie, Water quality.
Identifiers: Carbon-14 measurement, Shipboard incubation.

Carbon-14 measurements of surface water primary production of Lakes Superior, Michigan, Huron, and Erie are reported. Estimates are based on shipboard incubation of samples collected at irregular intervals during the 1967 and 1968 shipping seasons. Lake Superior proved to be the least productive of the lakes studied, mean surface productivity of 16.72 milligrams of carbon/cubic meter per day. The other lakes showed increasing levels of productivity: Lake Huron, 23.04 milligrams of carbon/cubic meter per day, Lake Michigan, 37.62 milligrams of carbon/cubic meter per day, and Lake Erie, 175.20 milligrams of carbon/cubic meter per day. Highest productivity levels in each lake tended to occur near large population centers. (Koonce-Wisconsin)
W70-02983

EFFECTS OF THERMAL STRATIFICATION UPON OXYGEN RESOURCES - JOHN H. KERR RESERVOIR,
Federal Water Pollution Control Administration, Charlottesville, Va. Middle Atlantic Region.
For primary bibliographic entry see Field 05C.
W70-03070

HYDROLOGY OF SMALL WATER AREAS IN THE PRAIRIE POTHOLE REGION,
Geological Survey, Washington, D.C.
W. S. Eisenlohr, Jr.
Canadian Wildlife Service Report Series, No 6, Saskatoon Wetlands Seminar, p 35-39, 1969. 5 p, 2 fig, 2 ref.

Descriptors: *Water balance, *Hydrologic budget, *Lakes, *Ponds, *Playas, Water chemistry, Water quality, Inflow, Evapotranspiration, Limnology, Water levels, Vegetation effects, Sedimentation.
Identifiers: Saskatchewan, Prairie potholes.

The hydrology of prairie potholes is briefly reviewed in a paper presented in a wetlands seminar. Potholes, usually shallow ephemeral lakes, are filled by rainfall on the surface of the lake, seepage, and surface inflow, and empty by seepage, evaporation, and surface outflow. When the soil is frozen it is impermeable and basin inflow takes place easily. If snow melts gradually, much of the water can evaporate. If snow melts after the ground thaws, water can seep into the ground. These conditional effects on the melting of snow can obliterate and even reverse the effects of total seasonal or annual precipitation. Basin inflow will occur only when rain falls on frozen or saturated soil, or at a greater rate than the maximum infiltration capacity of the soil. Soil moisture and to some extent the magnitude of a storm, are the effective controls over the amount of precipitation that becomes basin inflow, and that annual precipitation is meaningless as a measure of water replenishment in a slough. Vegetation affects water loss from a pothole in two ways: (1) it reduces the loss from evaporation by sheltering the water surface from incoming radiation, and (2) it may increase the loss by the amount of water is transpires. Evaporation makes the contents of a slough more saline than the inflow. Overflow, through periodic flushing, may well keep dissolved solids in many potholes from becoming very concentrated. (Knapp-USGS)
W70-03081

THE LIMNOLOGY OF ONEIDA LAKE - AN INTERIM REPORT,
Geological Survey, Albany, N.Y.
Phillip E. Greeson, and George S. Meyers.
New York Water Resources Commission Report of Investigation RI-8, 1969. 64 p, 23 fig, 13 tab, 53 ref.

Descriptors: *Limnology, *New York, *Eutrophication, *Algae, Water quality, *Nutrients, Waves (Water), Seiches, Water pollution effects, Water pollution sources, Runoff, Agricultural chemicals, Nitrates, Phosphates, Water chemistry.
Identifiers: *Oneida Lake (N Y).

The general concepts of lake eutrophication are discussed and the findings of the first year of field investigations on the eutrophication of Oneida Lake, New York are presented. Routine biological and chemical data revealed that the lake has become eutrophic both through the natural processes of lake aging and from the inflow of nutrient-rich water from the fertile drainage basin. The four most important factors affecting the biological activities within the lake are: (1) the high fertility of the drainage basin, (2) the physical position and shallowness of the lake, (3) mixing of the water by wind action, and (4) the inclusion of bottom sediments in the recycling of nutrient materials. (Knapp-USGS)
W70-03101

COMPUTATION OF RESERVOIR SEDIMENTATION WITH SUSPENDED LOAD (CZECH),
For primary bibliographic entry see Field 02J.
W70-03118

LAKE MICHIGAN OPEN WATER AND LAKE BED SURVEY 1968.
Illinois State Sanitary Water Board, Springfield.
For primary bibliographic entry see Field 05A.
W70-03140

2I. Water in Plants

LICHENOMETRY TO EVALUATE CHANGES IN GLACIAL MASS BUDGETS: AS ILLUSTRATED FROM NORTH-CENTRAL BAFFIN ISLAND, N.W.T.,
Colorado Univ., Boulder. Inst. of Arctic and Alpine Research; and Colorado Univ., Boulder. Dept. of Geological Sciences.
J. T. Andrews, and P. J. Webber.
Arctic and Alpine Research, Vol 1, No 3, p 181-194, Summer 1969. 14 p, 9 fig, 1 tab, 24 ref.

Descriptors: *Lichens, *Glaciation, *Glaciers, *Arctic, Ice, Sampling, Ablation, History, Mapping, Radioactive dating, Geomorphology, Geology.
Identifiers: *Canada, Baffin Island, *Lichenometry.

Direct measurement of the growth of Alectoria minuscula over 4.3 growing seasons enables a further assessment to be made on the value of lichenometry around the Barnes Ice Cap. Detailed lichen sampling in two formerly glacierized valleys allows isophyses to be drawn for specific diameters of A. minuscula. The gradients of the isophyses are similar to those of lateral glacial features. These reconstructions define ice margins from about 1650 A.D. to the present time and enable glacier changes in length, area, and volume to be estimated for the Lewis and Pintail glaciers. Local differences in the trend of area or volume loss are explained by differences in deglacial history. Specific ablation for the expanded Lewis Glacier below the 500 m ice contour averaged about 1.5 m ice equivalent per year, a value not dissimilar to those determined on the present glacier of about 1.3 m ice equivalent. Sampling over extended distances on substrates of similar age around the Barnes Ice Cap indicates comparable maximum lichen diameters are present. The value of lichenometry in arctic areas is reaffirmed. (Gabriel-USGS)
W70-02873

DROUGHT HAZARDS TO SEED GERMINATION,
Nottingham Univ. (England). School of Agriculture.
For primary bibliographic entry see Field 03F.
W70-03234

THE CONTROL OF SEED GERMINATION BY WATER-RELATIONS,
Hebrew Univ., Jerusalem (Israel). Dept. of Botany.
Dov Koller.
Annals of Arid Zone, Vol 6, No 1, p 35-41, Mar 1967. 3 tab, 21 ref.

Descriptors: *Germination, *Seeds, *Soil-water-plant relationships, *Soil moisture, *Inhibitors, Plant physiology, Arid lands, Seed treatment, Moisture availability, Impermeability, Humidity, Air environment, Soil environment, Environment, Vegetation establishment, Permeability.
Identifiers: *Water potential, *Plant survival.

Seeds may come in contact with water under many conditions which are unsuitable for germination and survival. Plants have evolved germination-regulating mechanisms to insure success of the species. The author draws on data of his own and information already in the literature to review and summarize germination-regulating mechanisms actuated by water-relations. Many seeds contain water-soluble inhibitors which leach out of the seed coating only after enough water has flowed past the seed into the soil to assure sufficient moisture availability for successful plant establishment. Some seeds have water-impermeable coasts which become permeable only after exposure to relatively humid conditions for some time period. In arid lands this tends to limit possibility of germination to that season of the year favorable to plant establishment. Seeds of some species are inhibited from germination even in the presence of adequate soil moisture if the water potential is not appropriate for seedling survival. Presence of liquid water in contact with the seed is not sufficient for germination. Atmospheric humidity, cycles of wetting and drying, volume of water passing into the soil and water potential of the medium may all have significant effects on germination. In arid lands or areas subject to periods of drought these mechanisms may be important to survival potential of the species. (Crouse-Arizona)
W70-03235

THE ROOT GENERATING CAPACITY OF SEEDLING TRANSPLANTS AND THE AVAILABILITY OF SOIL MOISTURE,
California Univ., Berkeley.
Edward C. Stone.
Annals of Arid Zone, Vol 6, No 1, p 42-57, Mar 1967. 9 fig, 11 ref.

Descriptors: *Arid lands, *Ponderosa pine trees, *Root development, *Planting management, *Moisture availability, Moisture stress, Soil-water-plant relationships, Semiarid climates, Plant growth, Field capacity, Soil environment, Timing, Temperature, Forestry, Forest Management, Coniferous trees, Plant physiology.
Identifiers: *Seedlings, *Plant survival.

Survival of forest tree seedlings planted in arid or semiarid climates is highly dependent on root

growth during the first growing season after planting. In the case of bare root seedlings, new root growth is strongly dependent on available soil moisture and physiological potential of the plant to grow new roots rapidly. The author tested several conifer species but found that only one, Pinus ponderosa Laws. (Ponderosa pine) seemed to have potential for survival under arid conditions. This paper presents a summary of recent literature on root growth potential of bare-root nursery stock and the author's own research into the root regenerating potential (RRP) of ponderosa pine. Since it is not always possible in arid and semiarid lands to plant when the soils are at or near field capacity, the author conducted studies of the RRP of ponderosa pine in soil at 100, 50, and 20% initial available soil moisture. A simple assessment technique is presented for determining effects of nursery location and cultural practices of the RRP of seedlings. It should also be possible to estimate survival rate of seedlings at various planting sites if soil moisture and temperature sequences of the site are known. By establishment of nurseries at different locations it should be possible to produce seedlings with a high RRP for planting at different times. (Crouse-Arizona)
W70-03236

WATER MOVEMENT IN INJECTED TREES,
Bartlett Tree Research Labs., Stamford, Conn.
Johnson Parker.
Annals of Arid Zone, Vol 6, No 1, p 58-65, Mar 1967. 4 tab, 7 ref.

Descriptors: *Droughts, *Absorption, *Deciduous trees, *Plant physiology, *Translocation, Plant diseases, Nutrients, Dye releases, Tracers.
Identifiers: *Plant water movement.

Drought with resulting soil moisture stress is thought to be a cause of several diseases of broadleafed deciduous trees. The author reports a study of the movement of water injected into trees as one step toward better understanding of this procedure. Distilled water was injected into 6 species: white oak, beech, red maple, red oak, American elm, and ash. Different species absorbed substantially different amounts of water although the amount varied widely among different trees of the same species and on the same tree on different days. Dyed water moved both up and down but tended to remain in a narrow path in the ring porous species, while in diffuse porous species it spread laterally about one inch for each foot of travel. Addition of any dissolved substance, even nutrient solutions, caused a sharp drop in the rate of water uptake. (Crouse-Arizona)
W70-03237

INTERRELATIONSHIP OF HABITAT TO GROWTH AND COMPOSITION OF ZIZYPHUS NUMMULARIA,
Central Arid Zone Research Inst., Jodhpur (India).
P. C. Nanda.
Annals of Arid Zone, Vol 6, No 1, p 66-73, Mar 1967. 4 tab, 2 ref.

Descriptors: *Arid lands, *Plant morphology, *Soil moisture, *Storage capacity, *Soil-water-plant relationships, Environmental effects, Moisture stress, Plant growth, Moisture availability, Soil types, Leaves, Water storage, Sands, Soil environment, Seasonal, Variability, Moisture content.
Identifiers: *India, Fruits, Rocky soils.

In arid lands available soil moisture becomes very low during long periods without precipitation. Plants are therefore growing under conditions of moisture stress. The author studied effects of moistures stress on the native species Zizyphus Nummularia on both deep sandy soil and a shallow rocky soil. The rocky soil had a higher moisture content during the rainy season, but because of greater total storage capacity, the sandy soil had more reserve moisture during long dry seasons. Plants on the sandy soil had less moisture content in leaves and smaller fruits. The sandy site plants put on new leaves and smaller fruits. The sandy site plants put on new leaves and developed flower buds two months earlier than plants on the rocky site. Plants on the sandy site retained leaves throughout the year whereas plants on the rocky soil dropped all leaves during the later months of the dry season. In general plants on sandy soils grew longer and faster than those on the rocky soil. There were distinct morphological differences between the same species grown on the two soil types. (Crouse-Arizona)
W70-03238

COMPARATIVE PLANT WATER RELATIONS,
Aberdeen Univ. (Scotland). Dept. of Botany.
For primary bibliographic entry see Field 02D.
W70-03239

2J. Erosion and Sedimentation

PRESENT RATE OF LAND EROSION,
University of East Anglia, Norwich (England). School of Environmental Sciences.
Anthony Young.
Nature, Vol 224, No 5222, p 851-852, Nov 29, 1969. 2 p, 2 fig, 41 ref.

Descriptors: *Erosion, *Geomorphology, *Land forming, Sediment load, Slopes, Topography, Cultivated lands, Sediment yield.
Identifiers: *Erosion rates.

Available estimates of the average worldwide erosion rate are reviewed. If results are divided into normal and steep relief groups, a clear difference in rates appears; normal or gentle slopes erode about 46 mm/1000 yr and steep slopes erode about 500 mm/1000 yr. These results are comparable with estimates based on sediment loads in streams. Agricultural land erosion is somewhat faster than the erosion of uncultivated land and this must be taken into account in estimating erosion rates in most areas. (Knapp-USGS)
W70-02860

GEOLOGICAL SIGNIFICANCE OF NORTH SEA SAND TRANSPORT RATES,
National Inst. of Oceanography, Wormley (England).
For primary bibliographic entry see Field 02L.
W70-02864

SEDIMENT TRANSPORT BY STREAMS IN THE WALLA WALLA RIVER BASIN, WASHINGTON AND OREGON, JULY 1962 - JUNE 1965,
Geological Survey, Washington, D.C.
B. E. Mapes.
Report available from Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price 60 cents (paper copy). Geological Survey Water-Supply Paper 1868, 1969. 32 p, 7 fig, 1 plate, 7 tab, 18 ref.

Descriptors: *Sediment transport, *Washington, *Bed load, *Suspended load, Sediment yield, Provenance, Sediments, Alluvium, Particle size, Sands, Silts, Clays, Data collections, Hydrologic data, Streamflow, Geology, Topography, Climates.
Identifiers: *Walla Walla River basin (Wash-Ore).

The Walla Walla River basin covers about 1,750 square miles in southeastern Washington and northeastern Oregon. The mountainous eastern part of the basin is underlain at shallow depth by basalt which has a residual soil mantle. The slopes are characterized by alluvial fans and deeply cut stream valleys filled with sand, gravel, and cobbles. Average annual sediment yields ranged from 420 tons per sq mi in the mountainous area to more than 4,000 tons per sq mi in the extensively cultivated northern and central parts. The highest concentrations were contributed by the loessal deposits in the Dry Creek drainage. Two runoff events resulting from rain and snowmelt on partially frozen ground produced 76% of suspended sediment discharged. Daily suspended-sediment concentrations for the Walla Walla River near Touchet exceeded 700 mg/l about 10% of the time, and 14,000 mg/l about 1% of the time. The mean concentration was 7,000 mg/l. Silt predominates in the suspended sediment. The bedload in the mountain and upland streams was about 5-12% as much as the suspended load. In the lower basin area, the bedload was about 2-8% as much as the suspended load. (Knapp-USGS)
W70-02879

RESPONSE OF A LABORATORY ALLUVIAL CHANNEL TO CHANGES OF HYDRAULIC AND SEDIMENT-TRANSPORT VARIABLES,
Geological Survey, Washington, D.C.
R. E. Rathbun, H. P. Guy, and E. V. Richardson.
Report available for sale by the Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $0.40 (paper cover). Geological Survey Professional Paper 562-D, p D1-D32, 1969. 32 p, 21 fig, 4 tab, 24 ref.

Descriptors: *Sediment transport, *Bed load, *Model studies, *Hydraulic models, *Flumes, Equipment, Instrumentation, Research and development, Calibrations, Sands, Sediments, Laboratory tests, Pumps.
Identifiers: *Sedimentation flumes, Recirculating flumes, Sediment-feed flumes.

The feed and recirculation systems of experimental sediment-transport flume operation were compared in a series of experiments conducted in a tilting plastic flume 10 meters long, 20 centimeters deep, and 20 centimeters wide. No significant differences were observed in the mean values of the sediment-transport rate, water-surface slope, depth of flow, and mean velocity for the two systems in the equilibrium steady state. The responses of the laboratory alluvial channel with a constant water discharge to changes of sand-bed slope, tail-water depth, and sediment-transport rate were determined. The recirculation system has the advantage of ease and economy of operation, and the feed system has the advantage of direct quantitative control of the sediment-transport rate. (Knapp-USGS)
W70-02880

RESULTS OF THE STUDY OF SUSPENDED LOAD RUNOFF OF THE RIVERS OF ROMANIA (FRENCH),
C. Diaconu.
Bulletin of the International Association of Scientific Hydrology, Vol 14, No 3, p 51-89, Sept 1969. 39 p, 3 fig, 15 tab, 5 ref, 2 append.

Descriptors: *Suspended load, *Runoff, *Rivers, *River flow, Hydrologic data, Sampling, Turbidity, Hydrologic properties, River basins, Statistical methods, Probability, Floods, Mapping, Erosion, Discharge measurement.
Identifiers: *Romania.

The methods and the results obtained during the 1951-1967 period for the determination of water discharge, turbidity, and suspended load of the rivers of Romania are described. The recorded data given as the annual, monthly, and discreet values show that in the interior rivers of Romania the maximum river discharge is much greater than 1.25 times the mean annual discharge. (Gabriel-USGS)
W70-02885

SUSPENDED LOAD TRANSPORT BY STREAMFLOWS (FRENCH),
Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France).
F. Fournier.
Bulletin of the International Association of Scientific Hydrology, Vol 14, No 3, p 7-49, Sept 1969. 43 p, 5 tab.

Descriptors: *Suspended load, *Sediment transport, *Streamflow, Sediments, Erosion, Deposition (Sediments), Hydrologic data, Rivers, Estuaries, Climates, Gaging stations, River basins, Tropical regions, Subtropic, International Hydrological Decade.
Identifiers: *World rivers, World sedimentation rates.

A detailed study was made of the suspended load transported by the rivers of the world on the basis of data recorded at 140 gaging stations located at 107 rivers prior to 1967. The data are arranged in tables in accordance with gaging station locations, watershed discharge areas, climatic conditions, and monthly transports of suspended load. (Gabriel-USGS)
W70-02886

THE NORTH BOSQUE WATERSHED INVENTORY OF A DRAINAGE BASIN,
Baylor Univ., Waco, Tex. Dept. of Geology.
For primary bibliographic entry see Field 02E.
W70-03077

STANDARDIZATION OF PARTICLE-SIZE RANGES.
American Society of Civil Engineers, New York.

ASCE Proceedings, Journal of the Soil Mechanics and Foundations Division, Vol 95, No SM5, Paper 6795, p 1247-1252, Sept 1969. 6 p, 3 ref.

Descriptors: *Particle size, *Sediments, *Standards, Materials, Materials testing, Clays, Sands, Silts, Sedimentology.
Identifiers: Particle size standards.

A committee was formed of members of several scientific and technical societies to recommend particle size standards acceptable for the common use of their members. After considering the positions of the participating societies, the Intersociety Committee reached agreement on a joint statement regarding the status of grain-size classes for sand, silt, and clay. The upper size limits in mm of clay, silt and sand fractions now in common use are as follows: clay = 0.002, 0.0039, and 0.005; silt = 0.05 (No 270 sieve), 0.0625 (No. 230 sieve), and 0.074 (No. 200 sieve); sand = 2.0 (No. 10 sieve) and 4.76 (No. 4 sieve). The prospects of attaining agreement on the upper size limits of clay seems good and we recommend the 0.002 mm limit. The possibilities of attaining agreement on the upper size limit of silt are slight to moderate, 0.0625 mm and 0.074 mm seem reasonable alternatives, with slight preference for the 0.074 limit. The prospect of attaining agreement on the upper sand size limit seems moderate to good and the 2.0 mm limit is recommended. (Knapp-USGS)
W70-03093

SEDIMENTATION IN UPPER STONY CREEK BASIN, EASTERN FLANK OF THE COAST RANGES OF NORTHERN CALIFORNIA,
Geological Survey, Washington, D.C.
J. M. Knott, and C. A. Dunnam.
Report available for sale by Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $0.25 for paper copy. Geological Survey Water-Supply Paper 1798-F, p F1-F35, 1969. 35 p, 11 fig, 9 tab, 20 ref.

Descriptors: *Sedimentation, *Small watersheds, *Reservoir silting, *California, Suspended load, Bed load, Sediment transport, Streamflow, Storm runoff, Stream erosion, Sediment yield.
Identifiers: Coast Ranges (Calif).

Sediment surveys in 1960 and 1962 indicated that the average annual rate of accumulation in East Park Reservoir, California during the period 1910-62 was 0.37 acre-ft per sq mi of drainage area and that in Stony Gorge Reservoir during the period 1928-62 it was 0.27 avre-ft per sq mi. Maximum deposition occurred in the deeper parts of the reservoirs along prereservoir stream channels. Storage capacity of both reservoirs has been depleted approximately 0.1% per year by sediment deposition. Estimates of suspended-sediment discharge were made from periodic measurements on Stony Creek at Black Butte Dam. Annual sediment yield at this site averaged 0.93 acre-ft per sq mi during the 6-year period 1957-62. Most of the sediment load of Stony Creek and its tributaries is transported during periods of storm runoff. The sediment is predominantly of silt and clay size (less than 0.062 mm). Bedload discharge is a minor part of the Stony Creek sediment discharge. The bedload, as computed by 3 procedures (Einstein, Meyer-Peter and Muller, and Schoklitsch), was 1-6% of the suspended load. (Knapp-USGS)
W70-03099

HYDROMORPHOLOGICAL PRINCIPLES OF COMPUTATIONS OF FREE MEANDERING: 1. SIGNS AND INDEXES OF FREE MEANDERING,
N. Ye. Kondrat'yev.
Trans from Trudy GGI, No 155, p 5-38. Soviet Hydrology: Selected Papers, No 4, p 309-335, 1968. 23 fig, 5 tab, 10 ref.

Descriptors: *Channel morphology, *Meanders, Rivers, Equations, Channels, River flow, Sediment transport, Stream erosion, Alluvial channels, Sedimentary structures.
Identifiers: USSR, Channel geometry.

Four major topics dealing with free meandering are quantitatively treated. These topics are: (1) Signs and indexes of free meandering; (2) horizontal deformation of meanders during free meandering; (3) structure of the velocity field of flow in a meander of a river; and (4) computations of the deformations of a meander in free meandering. The following methods of computations are presented: (1) Computation of horizontal deformations; (2) formula for constructing the axial line of channel; (3) computation of the horizontal position of a pool hollow by Garbrecht's method; and (4) computation of the pool hollow in a single-pool meander. These methods are compared and their advantages and limitations are discussed. (Carstea-USGS)
W70-03107

DISCHARGE OF SUSPENDED SEDIMENTS IN THE DON RIVER,
V. V. Krayushin.
Transl from GGI, Sbornik Rabot po Gidrologii, No 8, p 144-151, 1968. Soviet Hydrology: Selected Papers, No 4, p 400-407, 1968. 3 fig, 7 tab, 9 ref.

Descriptors: *Sediments, *Sediment transport, Rivers, Reservoirs, Sediment discharge, Hydraulic structures, Discharge (Water), River flow, Trap efficiency, Silting, Reservoir silting.
Identifiers: *USSR, Don River, Tsimlyansk Reservoir.

The channel formation process and the operating conditions of many hydraulic installations are affected by the magnitude and regime of sediment discharge. Discharge of suspended sediment in the Don River is examined under a natural regime and with the Tsimlyansk Reservoir as a sediment accumulator. Although the suspended sediment discharge depends mainly on water discharge, there is no strict proportionality between these two parameters. The Tsimlyansk Reservoir is essentially a sediment trap for the upper, middle, and lower Don. The computations show that about 17 to 82% of the annual discharge of suspended sediments is lost at the present time in the Tsimlyansk Reservoir. (Carstea-USGS)
W70-03111

COMPUTATION OF RESERVOIR SEDIMENTATION WITH SUSPENDED LOAD (CZECH),
Jaroslav Sumbal.
English summary. Vyskumny Ustav Vodneho Hospodarstva, Bratislava, Prace a studie 51, 1968. 65 p, 19 fig, 6 tab, 15 ref.

Descriptors: *Reservoir silting, *Sedimentation, *Suspended load, *Mathematical studies, Forecasting, Water levels, Analog computers, Discharge (Water), Mapping, Hydraulic models.
Identifiers: Reservoir sedimentation.

Reservoir silting is analytically investigated on the basis of G. I. Samov's method (1954). The computation of silting is based on the assumption that the fall velocity of the suspended load particles in turbulent flows can be expressed mathematically as a function of some critical velocity. The solution of final equations derived by using this technique, by nomograms, numerically, and by analog computer yields probable heights and spatial distribution of sediments in water reservoirs. (Gabriel-USGS)
W70-03118

2K. Chemical Processes

ATTENUATION OF SELECTED NITROGEN FORMS BY SORPTION FROM AQUEOUS SOLUTION ONTO NATURAL SOILS,
Michigan State Univ., East Lansing. Coll. of Engineering.
For primary bibliographic entry see Field 05B.
W70-02843

OCCURRENCE AND DISTRIBUTION OF MOLYBDENUM IN THE SURFACE WATER OF COLORADO,
Geological Survey, Washington, D.C.
Paul T. Voegeli, Sr., and Robert U. King.
Geol Surv Water-Supply Paper 1535-N, p N1-N32, 1969. 32 p, 1 fig, 1 plate, 3 tab, 7 ref.

Descriptors: *Water chemistry, *Trace elements, *Molybdenum, *Colorado, Data collections, Hydrologic data, Sampling, Surveys, Exploration, Mining, Water quality, Geochemistry.
Identifiers: Geochemical prospecting.

Molybdenum was detected in 89% of the samples collected from all the principal Colorado streams and their chief tributaries and from a few reservoirs and lakes. Amounts detected ranged from 1 to 3,800 micrograms per liter. The greatest amounts of molybdenum detected were in samples from the Colorado River at and below Kremmling, the Dillon Reservoir, the Blue River below Kremmling, the Dillon Reservoir, the Blue River below Dillon Dam, the Eagle River, and Tenmile Creek. (Knapp-USGS)
W70-02878

NITROGEN FIXATION ASSESSMENT BY ACETYLENE REDUCTION,
Oregon State Univ., Corvallis.
Robert V. Klucas.
Proceedings of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ, Berkeley, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Ore, Pac Northwest Water Lab, p 109-116. 2 tab, 30 ref.

Descriptors: *Nitrogen fixation, *Assay, Eutrophication, Aquatic environment, Microorganisms, Enzymes, Ammonia, Radioisotopes, Bacteria, Cyanophyceae, Lichens, Clostridium, Azotobacter.
Identifiers: *Acetylene reduction, Free-living systems, Ethylene, Symbiotic systems, Root nodules, Root-associated, Rhodospirillum rubrum, Anabaena cylindrica, Anabaena flos-aquae, Calothrix, Gloeotrichia echinulata, Nostoc entophytum, Nostoc muscorum, Mastigocladus laminosus, Tolypothrix tenuis, Glycine max, Myrica cerifera, Phaseolus vulgaris, Medicago sativa, Arachis hypogea, Pisum sativum, Comptonia peregrina, Alnus rugosa, Cycas revoluta, Zamia floridana, Collema, Peltigera, Pseudocyhel-

laria, Clostridium pasteurianum, Azotobacter Chroococcum, Azotobacter vinelandii.

Biological nitrogen fixation is the enzymic conversion of molecular nitrogen to ammonia. Growth on nitrogen-free medium has been used for screening for nitrogen fixing agents, but this method lacks sensitivity and requires extended investigative periods. The nitrogen-fixing complex reducing acetylene to ethylene is the basis for a new and sensitive assay for nitrogen fixation. The procedure exposes the organism to be tested to acetylene, incubating and analyzing the gas phase for ethylene. Of numerous methods used to measure ethylene, one especially sensitive method is by hydrogen-gas flame ionization gas chromatography. Evidence suggests that acetylene is reduced by nitrogenase. Acetylene reduction assay for nitrogen fixation has been used successfully with a number of free-living and symbiotic systems. The simplicity, sensitivity, and rapidity of the method is particularly adaptable to field investigations where numerous samples must be analyzed. One aspect of eutrophication is the nitrogen input into the aquatic environment; although many sources contribute to nitrogen increase, in situ fixation by microorganisms certainly is involved in this input. With the acetylene reduction assay, a simple and sensitive method is available for ascertaining the amount of nitrogen fixation in aquatic ecosystems. (See Vol 3, No 7, entry W70-02775). (Jones-Wisconsin)
W70-02963

CLAY MINERAL STABILITY AND WATER COMPOSITION,
Washington State Univ., Pullman.
For primary bibliographic entry see Field 05A.
W70-03026

GEOCHEMISTRY AND HYDROLOGY OF A SMALL BASIN IN THE UPPER BUFFALO RIVER WATERSHED, TENNESSEE,
Vanderbilt Univ., Nashville, Tenn., and Tennessee Div. of Water Resources, Nashville.
Richard G. Stearns, and John M. Wilson.
Interim Report, Tennessee Water Resources Research Institute, 1969. 3 p. OWRR Project A-011-TENN.

Descriptors: *Geochemistry, *Small Basin, *Hydrology, Rainwater, Groundwater, Surface Water, Weathering, *Leaching, *Precipitation, *Cherty Limestone, Soil, Residuum.

Passing through soil, rainwater pH drops 7 to 5 (CO_2 added); silica increases from 1 to 5 ppm, and calcium decreases from over 10 to less than 1 ppm. (Source of 'fallout' calcium is a mystery.) Groundwater regains calcium (to 50 or more ppm) and picks up more silica (to nearly 10 ppm) in the residuum. The surface stream is low in hardness (7 ppm) and pH (about 6) until it intersects permanent springs where it gains calcium (to 40 ppm) and pH increases (to about 7), as it mixed with groundwater that had been in contact with bedrock. Iron appears to be depositing at 4 pounds per acre per year. Silica appears to be carried away at 30 pounds per acre per year, and calcium at 8 pounds. Bedrock consists mainly of the minerals quartz, calcite and dolomite (cherty dolomitic limestone). Soil and residuum are impoverished in all but quartz, and there is an abrupt contact with a chert layer on bedrock. Groundwater percolates down to the top of rock where it moves laterally. Chert layers at least partially protect bedrock calcite from solution.
W70-03036

CHEMICAL QUALITY OF WATER IN NORTHERN NIGERIA, 1965-1968,
Geological Survey, Kaduna (Nigeria).
Raymond T. Kiser
Geol Surv Open-file Report, Dec 1968. 41 p, 1 fig, 6 tab, 7 ref.

Descriptors: *Water resources, *Surface waters, *Groundwater, *Water quality, Streamflow, Water wells, Springs, Water yield, Water utilization, Stock water, Domestic water, Irrigation water, Hydrologic data, Data collections.
Identifiers: *Nigeria.

More than 300 complete chemical analyses of water samples were collected during the period July 1965 to August 1968 from widespread sources in northern Nigeria. Most of the samples were obtained from groundwater sources, lakes, ponds, and streams in the Chad, West Chad, and Sokoto basins, Kerri Kerri area, Kaduna-Zaria area, and other scattered localities. The waters vary widely in dissolved solids concentration and chemical type, but most sources are suitable for livestock and man. Nearly half the water samples, however, from dug wells in West Chad basin and Kerri Kerri area have high nitrate, and many water sources from boreholes (drilled wells) in Chad and Sokoto basins have undesirable amounts of iron or manganese. Some groundwater sources, particularly in the Chad basin, are limited in their suitability for irrigation use because of salinity, sodium, or bicarbonate hazards. (Knapp-USGS)
W70-03072

SUMMARY OF WATER QUALITY STANDARDS FOR THE INTERSTATE WATERS OF ARKANSAS.
Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 05G.
W70-03083

DISCHARGE OF DISPERSED AND RARE ELEMENTS (MICROELEMENTS) IN SOLUTION AND IN SUSPENDED SUBSTANCES FROM THE TERRITORY OF THE USSR,
Nauchno Issledovatelskii Gidrokhimicheskii Institut, Novocherkassk (USSR).
A. A. Ivanova, and G. S. Konovalov.
Transl from Gidrokhimicheskiye Materialy, Vol 44, p 63-82, 1968. Soviet Hydrology: Selected Papers, No 4, p 336-353, 1968. 1 fig, 1 tab, 9 ref.

Descriptors: *Trace elements, *Water chemistry, *Water quality, Rivers, Watersheds (Basins), Cobalt radioisotopes, Copper, Molybdenum, Sediments, Manganese, Geochemistry.
Identifiers: *USSR, Silver, Vanadium, Nickel, Lead, Zinc.

Mechanical, physical, chemical, and biological processes taking place in a hydrographic basin are usually reflected in the amount of microelements removed from the land. The magnitude of the removal is also determined by the chemical properties of the elements themselves. Mountain rivers remove most of the microelements in suspension. In contrast, lowland rivers frequently remove microelements in solution. The USSR discharge of vanadium, manganese, cobalt, nickel, copper, zinc, lead, silver, and molybdenum is computed. The total amount of these elements which are removed into the sea is approximately 1,096,000 tons/year. Only one-fifth of this amount is removed in solution. (Carstea-USGS)
W70-03108

HYDROCHEMICAL STUDY OF ATMOSPHERIC PRECIPITATION,
P. P. Voronkov.
Transl from GGI, Sbornik Rabot po Gidrologii, No 8, p 67-81, 1968. Soviet Hydrology: Selected Papers, No 4, p 381-392, 1968. 6 tab, 14 ref.

Descriptors: *Water chemistry, *Water quality, *Precipitation (Atmospheric), Dust storms, Soils, Agricultural watersheds, Forest soils, Soil chemical properties, Snow cover.
Identifiers: *USSR, Kazakhstan, Altai.

The chemical composition of precipitation can change very rapidly in the southern regions of the USSR. In contrast, precipitation retains its characteristic chemical features for a long time in the northern regions. The upper soil layer can become a source of pollution of the air layer near the ground, as illustrated by observations in one of the lowland regions of the Altai. Significant differences were measured in the chemical composition of field and forest snow, and were attributed to soil dust. The snow water from the field had a much higher content of bicarbonate, Ca, and pH than the snow from forested land. Differences in the chemical composition of water obtained from the upper and lower snow layers are discussed for the steppe regions of Kazakhstan. The mineralization of water increased from upper to the lower snow layers. Examples from other geographic regions are given. (Carstea-USGS)
W70-03109

2L. Estuaries

GEOLOGICAL SIGNIFICANCE OF NORTH SEA SAND TRANSPORT RATES,
National Inst. of Oceanography, Wormley (England).
M. A. Johnson, and A. H. Stride.
Nature, Vol 224, No 5223, p 1016-1017, Dec 6, 1969. 2 p, 1 fig, 4 ref.

Descriptors: *Sediment transport, *Sands, *Bottom sediments, *Tidal waters, *Ocean currents, Tidal effects, Bed load, Sand waves, Ripple marks, Sediment yield, Provenance.
Identifiers: *North Sea, *Netherlands, *England.

In the southern part of the southern bight of the North Sea, tidal currents reach peak speeds of about 2 knots and the sea floor is composed of medium sand in large waves transverse to the flow. In the northern part, tidal currents are weaker and the floor of well-sorted fine sand is flat or ripple marked. The net sand transport is south to north, with erosion in the south and deposition in the northern reaches. Water depth is about 80-120 ft., both tidal and wind-driven currents are important. Transport rates obtained by use of a theoretical model using estimated currents, results of lab studies, wave measurements, and sedimentation data are consistent with quantitative data on sea floor changes. The small steady transport rate can be obscured by large storm flow events, but it is quantitatively more significant over long periods. The yearly net sand transport is about 2.4 million cubic meters. (Knapp-USGS)
W70-02864

THE CHESAPEAKE BAY INSTITUTE WAVE FOLLOWER,
Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
For primary bibliographic entry see Field 07B.
W70-02872

SALTWATER INTRUSION IN THE UNITED STATES,
American Society of Civil Engineers, New York. Hydraulics Div.
For primary bibliographic entry see Field 04C.
W70-02940

CALORIC AND CARBON EQUIVALENTS OF ZOOPLANKTON BIOMASS,
Fisheries Research Board of Canada, Dartmouth (Nova Scotia). Marine Ecology Lab.
Trevor Platt, Vivien M. Brawn, and Brian Irwin.
Journal Fisheries Research Board of Canada, Vol 26, No 9, p 2345-2349, 1969. 1 fig, 11 ref.

Descriptors: *Biomass, *Carbon, *Methodology, Zooplankton.
Identifiers: Caloric equivalents, Energy flow, Predictive equations, Second-order equations.

On the basis of zooplankton samples analyzed for caloric content, carbon, and ash, the dependence of caloric content of zooplankton (y) on percent organic matter (x) was described by the quadratic equation y = -3370 + 136x --0.514 x-squared. Carbon content and caloric content were highly correlated r = 0.94, 21 degree of freedom. Variation in energy equivalent of zooplankton (calorie/gram dry weight) was fivefold; variation appears as result of changing age distributions and species composition among plankton. Carbon content can be used as a reliable predictor of energy equivalent by the equation calorie/gram dry weight = -227 + 152 (% carbon). Multiple correlation coefficient among calories, carbon content, and ash was 0.98 (16 degree of freedom). Where carbon and ash contents are known, caloric content is predicted by the equation calorie/gram dry weight = 1351 + 106 (% carbon) -21.2 (% ash), with standard error of estimate being 253 calories. The seasonal variations in caloric content (fivefold variation caloric variation versus 14-fold variation in dry weight) suggest an expression of a compensatory mechanism in energy flow. (Voigtlander-Wisconsin)
W70-02967

DO MARINE CRUSTACEANS RELEASE DISSOLVED AMINO ACIDS,
Virginia Inst. of Marine Science, Gloucester Point; and Georgia Univ., Athens. Dept. of Zoology.
For primary bibliographic entry see Field 05C.
W70-02976

EVALUATION OF FLOW IN TIDAL REACHES OF THE CONNECTICUT RIVER BY MATHEMATICAL MODEL,
Geological Survey, Washington, D.C.; and Geological Survey, Hartford, Conn.
Chintu Lai, Frederick H. Ruggles, and Lawrence A. Weiss.
Paper presented at 50th Annual Meeting of American Geophysical Union, Wash, DC, Apr 21-25, 1969. 16 p, 9 fig, 4 tab.

Descriptors: *Estuaries, *Rivers, *Mathematical models, River flow, Model studies, Water supply, Sewage disposal, Unsteady flow, Boundaries (Surfaces), Discharge (Water), Tidal waters, Channel morphology, Theoretical analysis.
Identifiers: Connecticut River, Characteristics method.

The Connecticut River has been used for many years for domestic and industrial water supplies, sewage disposal, agriculture, and recreation. The growing economic importance of this river has increased the demand for more reliable flow information in the estuary. Because of the unsteady nature of the flow, there are only limited streamflow data available prior to 1965, which probably limited the ability of engineers to design facilities to properly utilize its water. Research work in the field of unsteady open-channel flow led to digital models using mathematical methods, such as the method of characteristics. The unsteady flow computation using this technique was first performed for a short reach and extended later to a much longer reach. This mathematical method requires boundary value and channel geometry data as computer inputs. In addition, occasional discharge measurements through tidal cycles are necessary to determine essential coefficients and parameters, and to provide a means for checking the accuracy of modeling. With such a theoretical analysis of unsteady flow, the following stream hydrology data are now economically obtainable for engineering design: space- and time-wise variations of stage, velocity, and discharge; volume interchange; water-surface profile and its movement; and flushing time. (Carstea-USGS)
W70-03075

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

THERMOSORB PROCESS FOR DESALTING WATER,
Marquardt Co., Van Nuys, Calif.
A. W. Venolia.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $0.65. Office of Saline Water Research and Development Progress Report No 502, Dec 1969. 67 p, 33 fig, 10 tab, 13 ref. OSW Contract No 14-01-0001-1469.

Descriptors: *Desalination processes, *Activated carbon, *Resins, *Ion exchange, Separation techniques, Economic efficiency, Temperature, Thermal capacity, Aqueous solutions, Methodology, Sodium chloride, Feeding rates.
Identifiers: *Thermosorb process, Aqueous sodium chloride, Kinetic technique.

Experimental results are described that indicate carbon beds provide an attractive alternative to desalting with thermally cycled ion exchange resins. Inexpensive raw materials were used with moderate temperatures. No evidence of a durability problem was encountered in an uninterrupted desalting run of more than 2000 hr. Beds of salt-sorptive carbons appear to be competitive with the resin beds on the basis of effective capacity per weight of sorbent. Carbons probably will outperform ion exchange resins on the basis of initial cost and durability. (Lang-USGS)
W70-02844

GRAPHITIC OXIDE CONTAINING REVERSE OSMOSIS MEMBRANES,
Westinghouse Electric Corp., Pittsburgh, Pa.
L. C. Flowers, P. K. Lee, E. S. Bober, M. H. Gjertsen, and Daniel Berg.
Rep avail for sale by Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $1.75. Office of Saline Water Research and Development Progress Report No 418, Apr 1969. 202 p, 33 fig, 27 tab, 28 ref, 1 append. OSW Contract No 14-01-0001-550.

Descriptors: *Membranes, *Reverse osmosis, *Desalination processes, Clays, Clay minerals, Bentonite, Temperature, Acidity, Salts, Ions, Feeding rates, Sodium chloride, Membrane processes.
Identifiers: *Graphitic oxide membranes, Salt rejection efficiency, Vermiculite membranes, Bentonite membranes.

Reverse osmosis membranes containing graphitic oxide and membranes formed from bentonite and vermiculite were tested. The graphitic oxide membranes were tested by varying the temperature, pH, sodium chloride concentration and salt-ion valence of the feed solutions. These membranes showed a decrease in salt rejection from 85-90% to 75% with time, while flux increased from 2-5 to 7-10 gpd per sq ft. Aging may be the reason for the changed performance. Bentonite membranes with sodium hexametaphosphate or tannic acid as edge modifier had a rejection efficiency of 57% and 60% respectively. The efficiencies of vermiculite membranes were approximately 10%. (Carstea-USGS)
W70-02845

STUDY OF METHODS TO RETARD COMPACTION OF CELLULOSE ACETATE MEMBRANES IN REVERSE OSMOSIS DESALINATION,
DeBell and Richardson, Inc., Hazardville, Conn.
Bernard Baum, Stanley A. Margosiak, and William H. Holley.
Rep avail for sale by Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $0.70. Office of Saline Water Research and Development Progress Rep No 467, Oct 1969. 75 p, 13 fig, 17 tab, 18 ref, 2 append. OSW Contract No 14-01-0001-1177.

Descriptors: *Reverse osmosis, *Desalination processes, *Membranes, Cellulose, Pigments, Reinforcement, Permselective membranes, Permeability, Desalination apparatus, Compaction, Aluminum, Silicates.
Identifiers: *Cellulose acetate membrane, Unfilled membrane, Burgess KE reinforced membrane.

Cellulose acetate can be effectively crosslinked with hexamethoxymethyl melamine, acetyl acetonate titanium chelate, sodium dichromate, or lead oxide to prevent desalination membrane compaction. Only pigment reinforcement was promising in preventing the creep of pastics under mechanical stress. Flat membranes were tested for salt rejection, intrinsic salt permeability, intrinsic water permeability, and thickness before and after desalination use in a high-pressure reverse osmosis desalination apparatus. The following types of membranes were used in experimental work: (1) unfilled membranes; (2) Burgess KE reinforced membranes and (3) Burgess KE reinforced and coated membranes. Burgess KE on anhydrous, organic-coated aluminum silicate was the most effective pigment tried for reducing wet compressive creep. (Carstea-USGS)
W70-02846

ULTRASONIC DETECTION OF CALCIUM SULFATE SCALE ON METAL SURFACES,
Midwest Research Inst., Kansas City, Mo.
Fred R. Rollins, Jr.
Rep avail for sale by the Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $0.50. Office of Saline Water Research and Development Progress Rep No 444, June 1969. 39 p, 22 fig, 4 ref. OSW Contract No 14-01-0001-1718.

Descriptors: *Calcium sulfate, *Scaling, *Analytical techniques, *Desalination, Instrumentation, Heat transfer, Water temperature, Velocity, Research and development.
Identifiers: Ultrasonic detection, Transducers, Scale detection.

A study of ultrasonic reflectivity at liquid-metal interfaces where calcium sulfate scale is present led to a technique useful for fixed-station scale detection in saline water conversion plants. Small high-temperature transducers can be soldered directly to the outside surface of heat-transfer tubes. With suitable electronic gear, the system provides nearly exponentially decaying echo trains at frequencies from a few megahertz up to 20 MHz. These echo trains remain remarkably stable at water temperatures as high as 280 deg F and flow velocities of 3 ft/sec. The decay rate of the echo train is strongly affected by the presence of scale on the inside surfaces of the heat transfer tube. The sensitivity of the technique for scale detection increases with increased frequency; but problems such as attenuation by water ultimately set an upper limit on a practical frequency. The decay rate also depends on the exact nature of the scale. The technique appears to be capable of detecting deposits with thicknesses of 1 mil or more.
W70-02847

STUDY OF 250-MGD MULTISTAGE FLASH DISTILLATION PLANT WITH TWO-LEVEL BRINE FLOW: PART 1. DESIGN AND COST ESTIMATE.
Oak Ridge National Lab., Tenn.

Rep avail for sale by Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $3.50. Office of Saline Water Research and Development Progress Rep No 389, Mar 1969. 78 p, 2 fig, 8 tab, 3 ref, 2 append. ORNL-OSW Agreement No 14-01-0001-534.

Descriptors: *Cost analysis, *Desalination processes, *Desalination plants, Brines, Flow, Capital costs, Economics, Design criteria, Distillation.
Identifiers: Multistage flash distillation plants, Oak Ridge National Laboratory.

Cost estimates were obtained for a 250-mgd multistage flash desalination plant designed by the Oak Ridge National Laboratory. Development of design criteria was based on the assumption that the plant would be located in southern California. Preparation of cost estimates included capital, operating and maintenance costs. A 250-mgd multistage flash desalination plant can be built at a cost of $149,725,000. Annual operating costs with a 5.6% charge rate will amount to 20.6 cents/1000 gallons. (See W70-02850). (Carstea-USGS)
W70-02849

STUDY OF 250-MGD MULTISTAGE FLASH DISTILLATION PLANT WITH TWO-LEVEL BRINE FLOW: PART 2. PRELIMINARY ENGINEERING ANALYSIS AND CAPITAL COST ESTIMATE.
Bechtel Corp., San Francisco, Calif.

Rep avail for sale by Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $3.50. Office of Saline Water Research and Development Progress Rep No 389, Mar 1969. 176 p, 26 fig, 2 tab, 4 ref, 3 append. Oak Ridge Nat Lab-OSW Agreement No 14-01-0001-534 ORNL-Bechtel Corp Subcontract No 3084.

Descriptors: *Capital costs, *Desalination plants, Brines, Flow, Distillation, Cost analysis, Evaporators, Economics, Design criteria, Design flow.
Identifiers: *Multistage flash distillation plants.

A preliminary engineering review was made and a capital cost estimate was made of a 250-mgd multistage flash evaporator desalting plant. The following work was performed: (1) structural, mechanical, instrumentation and electrical engineering review of the plant design provided by the Oak Ridge National Laboratory; (2) a preliminary estimate of capital cost for the plant. A 250-mgd plant could be designed and built in southern California for $149,725,000. The costs of spare parts and replacements were not included in this estimate. (See W70-02849). (Carstea-USGS)
W70-02850

LIMITING CURRENTS IN ELECTRODIALYSIS MEMBRANE CELLS,
N. W. Rosenburg, and C. E. Tirrell.
Water Research Foundation of Australia Report No 29, Papers from Symposium on Aspects of Saline Water held at Adelaide, Feb 20-21, 1969, p 4.1-4.11, Sept 1969. 11 p, 6 fig, 3 tab, 15 ref.

Descriptors: *Electrodialysis, *Membrane processes, *Desalination processes, Electrochemistry, Chemical properties, Water purification, Saline water, Electrolytes, Ion transport, Currents (Water), Turbulent flow, Efficiencies.
Identifiers: Electrodialysis cell design.

High density currents passed through cells containing ion-transfer membranes are limited by concentration gradients occurring at membrane-solution interfaces. In unstirred solutions, high electrical resistance pH changes, and low current efficiencies occur if ratios of current density to solution concentration in meq per cc are above 50 ma per sq cm. By using high velocity solution flow past membrane faces, this limiting current ratio can be increased to above 500. High linear velocities, thin cell spacing, and in the streamline flow region, closely spaced eddy-promoting obstructions are desirable to maximize permissible current densities. It is concluded that turbulent flow, to be effective, must be obtained by increased velocity instead of increased cell thickness. (Knapp-USGS)
W70-02851

HYDRATE REACTION KINETICS AND ICE CRYSTAL GROWTH RATES: 1. THE GROWTH RATE OF ICE CRYSTALS IN FLOWING SUBCOOLED WATER,
Syracuse Univ., N.Y.
Jacques Poisot.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $0.70. Office of Saline Water Research and Development Progress Report No 370, p 1-23, Nov 1968. 23 p, 11 fig, 3 tab, 14 ref. OSW Grant No 14-01-0001-1455.

Descriptors: *Growth rates, *Crystal growth, *Desalination processes, *Ice, Freezing, Ice-water interfaces, Melting, Brines, Flow, Heat transfer, Cooling, Fresh water.
Identifiers: *Ice crystal growth, Subcooled water flow.

The formation of ice crystals which are later melted to regenerate pure water is involved in freezing processes for desalting saline waters. Growth rates of single ice crystals in flowing subcooled water and brine are discussed. The design of a new cell made it possible to reduce the time necessary to prepare the run itself. Four water velocities have been studied; namely 1.0, 2.18, 8.0 and 16.0 cm/sec, and the degrees of subcooling varied between 0.05 deg C and 0.70 deg C. The growth equation predicts a zero growth in quiescent water for any degree of cooling. The experimental data show that variation of the flow velocity allows control of the heat transfer away from at least part of the crystal. As a practical application it seems possible to save on cost of refrigeration by increasing the fluid velocity, or to obtain growth as fast as desired. The industrial application is more complex and is briefly described. (See W70-03074). (Carstea-USGS)
W70-03073

HYDRATE REACTION KINETICS AND ICE CRYSTAL GROWTH RATES: 2. THE RATE OF FORMATION OF FREON 31 HYDRATE,
Syracuse Univ., N.Y.
Gilbert M. Roux.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $0.70. Office of Saline Water Research and Development Progress Report No 370, p 24-71, Nov 1968. 48 p, 10 fig, 17 tab, 22 ref, append. OSW Grant No 14-01-0001-1455.

Descriptors: *Rates, *Hydrates, *Desalination processes, Hydration, Sodium chloride, Sea water, Temperature, Crystallization, Salts.
Identifiers: Methyl-bromide hydrate, Hydration desalination.

The development of the hydrate process for seawater desalination requires the knowledge of the reaction rate of the hydrate used (F-31). The formation rate of F-31 hydrate was studied in aqueous solutions of sodium chloride in a one gallon continuously stirred reactor. The main independent variables studied were the effects of agitation, temperature driving force, salt concentration, and fraction of liquid hydrating agent. Liquid F-31 has been found to hydrate 6 times as fast as does methyl bromide for the same agitation rate (0.07 hp/gal). Above temperature differences greater than 0.3 deg C and for 0.19 hp/gal input to the reactor, the reaction rate varies approximately as the square of the temperature difference. The presence of 5.3 wt.% NaCl causes a decrease in the reacation rate, presumably because of transport of salt away from the crystallization site. The rate was found to be dependent on the relative amount of liquid hydrating agent in the reactor when this amount was less than 3% by volume. (See W70-03073). (Carstea-USGS)
W70-03074

CONCENTRATION OF SEAWATER BY ELECTRODIALYSIS,
Japan Monopoly Corp.
M. Kaho, and T. Watanabe.
Paper presented at 3rd Symposium on Salt sponsored by Northern Ohio Geological Survey, Salt Institute, and Solution Mining Research Council, Cleveland, Ohio, Apr 21-24, 1969. Industrial Water Engineering, Vol 6, No 11, p 30-32, Nov 1969. 3 p, 4 fig.

Descriptors: *Desalination, *Electrodialysis, *Salts, *Byproducts, *Costs, Membrane processes, Separation techniques, Electrochemistry.
Identifiers: Salt production (Electrodialysis).

The sea is the sole raw material for salt production in Japan, and 120,000 tons or 13% of the total annual production of salt is now obtained by electrodialysis. The cost of salt production can be reduced by increasing the operating current density, improving the membrane permselectivity to univalent ions, the utilization of by-products, and a combination of a dual purpose plant (power generation and desalination) and salt production with ion-exchange membranes. The dual purpose plant will make it possible to obtain concentrated seawater which in turn will make operation at higher current densities than at present feasible. (Knapp-USGS)
W70-03079

3B. Water Yield Improvement

PRECIPITATION AFFECTS INCREASES IN STREAMFLOW AFTER CONVERTING BRUSH TO GRASS IN ARIZONA,
Agricultural Research Service, Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
Alden R. Hibbert.
Paper presented at 50th Annual Meeting of American Geophysical Union, Wash, DC, Apr 21-25, 1969. 22 p, 5 fig, 2 tab, 7 ref.

Descriptors: *Water yield improvement, *Clear-cutting, *Watershed management, *Rainfall-runoff relationships, *Arizona, Precipitation (Atmospheric), Streamflow, Brush, Grasslands, Seasonal, Rainfall, Winter, Summer, Water yield, Demonstration watersheds.
Identifiers: Chaparral removal.

Water yield has increased substantially on two small chaparral watersheds in central Arizona following control of brush and conversion to grass. The increases in streamflow on the treated watersheds have varied from 1.5 to 14.0 inches per year during the past 7 years. Winter precipitation appears to be the dominant factor controlling the amount of increase. Summer rainfall normally accounts for about one-third of the annual precipitation, but generally has little effect on streamflow. When annual precipitation is less than 16 inches, the increase in water yield for that year is likely to be less than 2 inches. However, the efficiency of the conversion for producing extra water improves as rainfall increases, at least up to 34 inches. At 34 inches of annual precipitation, the increase in flow may reach 12 inches or more, depending on seasonal distribution of the rainfall. (Carstea-USGS)
W70-02882

THE CHANGING ROLE OF WATER IN ARID LANDS,
Gilbert F. White.
Tucson, Arizona, The University of Arizona Press, 1962. 15 p.

Descriptors: *Arid lands, *Water management, Recreation, Water allocation, Industrial water, Urbanization, Population, Pricing, Irrigation, Water supply, Forecasting.
Identifiers: Trends, Santa Cruz Valley, Colorado basin, Social aims, Public attitudes, Nomadism, Recreational use.

A few trends may be noted from the spotty experience of the arid one-third of the earth's land

surface. The current vogue of projecting our resource future by extrapolating past trends in the use and supply of natural wealth has heuristic value in trying to ascertain the future but it carries the danger of these trends being accepted as possible guides for that growth. Sometimes they obscure realization that a present view of resources in itself shapes future use of those resources. As such, the author is provided with an excuse for reviewing familiar experience with water management. Today's vision of the role of water in the Santa Cruz Valley, in the Colorado basin, and in the arid zone as a whole, seems likely to affect the complex of individual decisions determining how remaining waters of those areas will be allocated or reallocated for human use in the decades ahead. According to the framework of public attitudes in which both familiar and unfamiliar hydrologic facts are arranged, water may be cast in roles which will either inhibit or advance social aims. These public attitudes may be expected to reflect in some measure the sweeping changes in social progress and its forces and in turn determine the water allocation decisions of the future. (Loeb-Rutgers)
W70-03014

DELINEATION OF SHEAR ZONES AND APPLICATION TO RESERVOIR ENGINEERING USING APOLLO 9 MULTISPECTRAL PHOTOGRAPHY,
Alabama Geological Survey, Tuscaloosa.
For primary bibliographic entry see Field 07B.
W70-03069

EFFECTS OF CULTIVATION AND GRASS ON SURFACE RUNOFF,
Agricultural Research Service, Coshocton, Ohio. Corn Belt Branch.
Frank J. Dragoun.
Paper No H-28, presented at 50th Annual Meeting of American Geophysical Union, Wash, DC, Apr 21-25, 1969. 13 p, 3 fig, 3 tab, 7 ref.

Descriptors: *Rainfall-runoff relationships, *Cultivation, *Surface runoff, *Water yield improvement, Grasslands, Crops, Land use, Watersheds (Basins), Runoff, Nebraska, Great Plains, Watershed management.
Identifiers: Hastings (Neb).

More than a million acres of marginal cropland have been converted to permanent vegetation in the Great Plains, and conversion is proposed for many more acres. This report presents results of research showing the effect of drastic changes in land use on watershed surface runoff from 4-acre watersheds near Hastings, Nebraska. Surface runoff was significantly reduced two years after converting marginal cultivated fields to perennial grass, and was representative of runoff from native meadow after the third year. Conversely, runoff increased greatly the first year after native meadow was placed in cultivation. (Carstea-USGS)
W70-03088

WATER-RESOURCES APPRAISAL OF CLAYTON VALLEY-STONEWALL FLAT AREA, NEVADA AND CALIFORNIA,
Nevada State Dept. of Conservation and Natural Resources, Carson City.
F. Eugene Rush.
Nevada Department of Conservation and Natural Resources, Water Resources-Reconnaissance Series, Report 45, 1968. 54 p, 6 tab, 1 map, 3 fig, 34 ref.

Descriptors: *Nevada, *Arid lands, *Groundwater, *Water yield, *Water resources, California, Evapotranspiration, Groundwater basins, Valleys, Groundwater movement, Subsurface flow, Water quality, Saline water, Alkaline water, Mineral industry, Spring waters, Hydrologic aspects, Geology, Geologic formations, Phreatophytes, Hydrologic data, Surveys.

This report is a water resource reconnaissance appraisal of the Clayton Valley-Stonewall Flat area which extends from just south of Tonapah, Nevada, to the north end of Death Valley, California. Hydrologic characteristics of the 6 valleys of the study area are summarized. Evapotranspiration accounts for most of the natural discharge from the Clayton Valley while subsurface flow accounts for most of the loss from the remaining valleys. The only important perennial yield is an estimated 22,000 acre feet per year from the Clayton Valley of which only 2,000 is developed at present. The general geological structure and physiography of the area are discussed. The average growing season ranges from about 120 to 200 days depending upon elevation. General intervalley groundwater flow is from north to south with the southernmost units discharging into Death Valley. The area is located in a rain shadow, with average precipitation in the valleys of from 3 to 6 inches. Some mountain areas receive as much as 15 inches. Surface water flow is minimal. The groundwater quality ranges from fair to poor for agriculture and is marginal for domestic use. (Crouse-Arizona)
W70-03231

3C. Use of Water of Impaired Quality

SALINITY TOLERANCES OF CERTAIN TROPICAL SOILS AND RELATIONSHIPS BETWEEN SODIUM ION ACTIVITIES AND SOIL PHYSICAL PROPERTIES,
Hawaii Univ., Honolulu.
S. A. El-Swaify, L. D. Swindale, and G. Uehara.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $0.55. Office Saline Water Research and Development Progress Report No 419, Mar 1969. 49 p, 15 fig, 14 tab, 74 ref. OSW Grant No 14-01-0001-673.

Descriptors: *Tropical regions, *Soils, *Soil physical properties, *Soil chemical properties, *Hawaii, Calcium, Magnesium, Sodium, Soil water, Irrigation water, Hydraulic conductivity.
Identifiers: *Tropical soils, Soil salinity tolerances, Peptization.

Two tropical soils from Hawaii were tested for salinity tolerances, the ability of the soils to resist physical deterioration by saline waters. Hydraulic conductivity measurements showed that presently permissible limits of salinity and sodium in irrigation water can be safely raised because significant hazardous physical conditions are not likely to occur. Both soils possess high resistance to detrimental peptization even when exposed to extreme sodic conditions. The original acidities of soils are highly resistant to change under leaching. Neither soil had a tendency to accumulate soluble salts by extraction from percolating saline waters. The direct determination of ionic activities for sodium, calcium and magnesium ions as a new and more fundamental tool in soil salinity work is discussed. (Carstea-USGS)
W70-02848

UTILISATION OF SALINE WATER: THE ROLE OF DESALINATION,
Australian Mineral Development Labs., Adelaide.
N. V. Blesing, R. E. Wilmshurst, and J. D.
Melbourne.
Water Research Foundation of Australia Report No 29, Papers from Symposium on Aspects of Saline Water, held at Adelaide, Feb 20-21, 1969, p 3.1-3.9, Sept 1969. 9 p, 3 tab, 3 ref.

Descriptors: *Desalination, *Desalination processes, *Costs, Water quality, Water utilization, Water chemistry, Water demand, Saline water, Groundwater, Surface waters, Water supply Economics.
Identifiers: *Australia.

If sea-water is excluded, the role of desalination in permitting increased utilization can be shown to fall into one of two major categories, depending on the end use of the water. In one broad category are municipal uses - including domestic, industrial and agricultural, while the other includes pastoral applications. The water quality required for each of these uses is reasonably well defined, and the appropriate standards are presented and discussed. The processes available for achieving these qualities are reviewed and technical problems outlined. Comparative cost data are presented. A number of problems, not widely recognized, are defined, and approaches are suggested which may lead to wider recognition of the value of saline water. (Knapp-USGS)
W70-02854

SOME EXPERIENCE IN LEACHING OF SALINE SOILS IN SOUTH KAZAKHSTAN (RUSSIAN),
Ya. D. Kalinin.
Gidrotekhnika i Melioratsiya, No 8, p 66-75, Aug 1969. 2 fig, 8 tab, 7 ref.

Descriptors: *Saline soils, *Leaching, Climates, Seasonal, Crops, Cotton, Humidity, Irrigation engineering, Soil chemistry, Clays, Water demand, Plants, Geology, Groundwater, Water loss, Evaporation.
Identifiers: *USSR, Kazakhstan.

Methods for analysis of ground salt contents and leaching as deep as 40 meters are described on the basis of their application to a 2000-acre area in the saline area of Kazakhstan. The use of 3,500 to 7,500 cum of leaching water per acre on ground containing 0.75 to 1.75% salt gives the best results. Formulas are available to calculate the necessary water volumes for achieving efficient leaching in soils of various chemical compositions. (Gabriel-USGS)
W70-03124

INTRASOIL UTILIZATION OF SEWAGE WATER SEDIMENTS (RUSSIAN),
Institute of Medical Parasitology and Tropical Medicine (USSR).
N. A. Romanenko.
Gidrotekhnika i Melioratsiya, No 8, p 92-95, Aug 1969. 1 tab, 10 ref.

Descriptors: *Sewage disposal, *Sewage treatment, *Soil formation, *Soils, *Soil treatment, Pollutants, Agricultural engineering, Biological communities, Biology, Sampling.
Identifiers: *USSR, Sewage water sediments.

A method of introducing sewage water sediments into the soil and the results obtained are discussed on the basis of the data obtained at an experimental station in the Moscow region. Use of relatively shallow furrows for the introduction of sewage-water sediments into the soil leads to a higher productivity of several crops, such as potatoes, beets, etc. (Gabriel-USGS)
W70-03125

A STUDY OF THE TECHNICAL AND ECONOMIC FEASIBILITY OF USING SEWAGE EFFLUENT FOR IRRIGATION IN LINCOLN PARISH, LOUISIANA,
Louisiana Polytechnic Inst., Ruston. Dept. of Agricultural Engineering.
Charles W. Wilson, and Robert P. Centrell.
Available from the Clearinghouse as PB-189 085, $3.00 in paper copy, $0.65 in microfiche. Paper presented at American Society of Agricultural Engineers, Southwest Region, Baton Rouge, Louisiana, Apr 3-5, 1968. 34 p, 4 tab, 34 ref, 6 fig. OWRR Proj No A-009-LA.

Descriptors: *Irrigation practices, *Effluents, *Sewage disposal, *Waste water (Pollution), Legal aspects, Public health, Economic feasibility, Biochemical oxygen demand.
Identifiers: Lincoln Parish (La).

The sewage effluent used for irrigation acts as a natural fertilizer, and, such use is expected to increase the pollution abatement of streams and rivers. The technical aspects of using sewage effluent for irrigation purposes are: Corrosion potential, plugging effect of sprinkler nozzles, effect of storage reservoirs on effluent quality, effect of salts on soil and crops, effects of effluent on infiltration, effects of effluent on soil organisms, and fluctuating supply and demand for irrigation water. The following public health aspects are discussed: Organisms present in sewage effluent, pollution of soil and groundwater, and pollution abatement of water ways. Some legal aspects are discussed. The economic benefits of irrigation in humid areas depend large on good management practices. An economic analysis was made for each irrigation system in Lincoln Parish, Louisiana. (Grossman-Rutgers)
W70-03159

BRIEF INTRODUCTION TO SOME BASIC KNOWLEDGE ON SALINE SOILS,
Ching-Sheng Ch'en.
Available from the Clearinghouse as AD-692 153, for $3.00 in paper copy, $0.65 in microfiche. Ti Li (Geography), No 1, p 35-40, 1966. Edited translation FTD-HT-23-1109-68.

Descriptors: *Soil salinity, *Soil-water-plant relationships, *Saline soils, *Salts, Irrigation practices, Soil physical properties, Soil chemical properties, Salt tolerance, Irrigation, Drainage, Farm management, Agriculture, Plants, Climatic zones, Rice, Damages, Crop response, Soil classifications, Topography, Hydrogeology.
Identifiers: *China, Ning-hsia region, China.

The types of salts found in saline soils are listed and the effects on soil properties and plants of each salt are discussed. Saline soils are classified by degree of salinity. The types of crops that can be grown in each saline class are discussed. No agricultural crops will grow in soils with salt content of 1 percent or more. Virtually nothing will survive at 3 percent salt content. Types of soil salinity in various regions of China are presented in tabular form. The climatic conditions associated with saline properties in various regions are discussed. The dangers of secondary salinization are presented by region. Finally, the influence of proper irrigation and farming practices can improve or eliminate salinity problems. Application of too much water, rice growing in the wrong soil, or improper drainage can create a salinity problem. (Crouse-Arizona)
W70-03226

3D. Conservation in Domestic and Municipal Use

WATER SUPPLY FOR PORT-AU-PRINCE,
Centrale Autonome Metropolitaine d'Eau Potable (Haiti); MacLaren International Ltd., Toronto (Ontario); and Engineering-Science, Inc., Arcadia, Calif.
E. Limousin, H. Fennerty, and R. G. Ludwig.
Water and Sewage Works, Vol 116, No 7, p 272-275, July 1969. 4 p, 1 fig, 1 photo.

Descriptors: *Water supply, *Water sources, *Water management (Applied), *Municipal water, Water consumption, Water conveyance, Scaling, Water distribution (Applied), Water policy.
Identifiers: Port-au-Prince (Haiti).

Port-au-Prince, Haiti, currently obtains its water supply from springs which issue from the slopes of the Morne l'Hopital mountain ridge. The Morne l'Hopital is a limestone massive of the Oligocene period. Its geologic structure includes faults and fractures and it is along these faults that the springs appear. The yield of these springs has been increased by the construction of sub-surface collection pipe systems in the alluvial material and by tunnels (infiltration galleries) driven horizontally into the slopes of the Morne l'Hopital. The water supply sources serving the Metropolitan area are characterized by their relatively high calcium hardness, alkalinity and carbon dioxide. In addition they are in a state of supersaturation in varying degrees with respect to calcium carbonate. The present criteria for operation of the distribution system is that all consumers receive water for at least one hour per day. The average daily per capita requirement for the study area is estimated at 46 gpd. For fire, an allowance of 500 gpm was adopted for all areas except the main downtown district of the city, where an allowance of 1,000 gpm was adopted. The problem of supersaturation should be amenable to conventional treatment methods. First phase improvements are designed to supply the source and transmission needs through the year 1978. (Knapp-USGS)
W70-02870

CONSTRUCTION OF WATER MAINS AND SEWERS IN POPULOUS COUNTIES, LAKE IMPROVEMENTS, AND CONSERVATION OF NATURAL RESOURCES.

Wis Stat Ann secs 60.29 (16), 60.29 (19), 60.29 (29) (1957), 60.29 (44) (Supp 1969).

Descriptors: *Wisconsin, *Sewers, *Conservation, *Lakes, Conduits, Cities, Administrative agencies, Real property, Riparian land, Riparian rights, Projects, Project planning, Design, Cost, Construction, Value, Assessments, Benefits, Land use, Natural resources.
Identifiers: *Improvements.

Town boards may improve any lake situated in such town. The expense of such work may be paid by the town or by the owner of the property benefited, but assessments on real estate may not exceed the benefits accruing to it. Whenever a majority of the owners of riparian property on any lake petition for improvements, the town board shall make the improvements and assess benefits and damages as provided by this law. When authorized by town meetings, town boards may appropriate up to $5,000 annually for the conservation of natural resources or for payment to bona fide nonprofit organizations for conservation within town limits. Work on lakes and streams in the town must be approved by the State Conservation Commission. (Duss-Florida)
W70-02914

RECLAMATION OF WASTEWATER.
Los Angeles City Dept. of Water and Power, Calif.
For primary bibliographic entry see Field 05D.
W70-03141

ACQUISITION OF WATER RIGHTS BY PUBLIC WATER SUPPLY AGENCY.

Pa Stat Ann tit 32, secs 632-641 (1967).

Descriptors: *Pennsylvania, *Water rights, *Public utilities, *Water supply, Water sources, Eminent domain, Water yield, Water permits, Permits, Water policy, Water, Water management (Applied), Water contracts, Water control, Water utilization, Legislation, Legal aspects, Regulation, Administrative agencies, Appropriation.

Water rights of any public water supply agency which are unused within one year after the effective date of this act are hereby declared null and void. No acquisitions of water rights shall preclude the future acquisition of water rights in the same source unless the water supply shall within one year produce to the Water and Power Resources Board the record upon which such acquisition is founded. It shall be the duty of the Board to consider and pass upon such claims and to keep the Water Acquisitions Record. An actual taking of water for public use shall be construed as prima facie evidence of the validity of the claim, and confirmation by the Board shall constitute a validation of the right. No public water supply agency shall hereafter acquire water except as provided in this act. Any such agency desiring to acquire new water rights shall make application to the Board, which shall make necessary investigations and issue permits or modification orders. The Board may revoke permits for non-use or extend the time for acquiring said water rights. Such agencies shall have the power of eminent domain regarding rights named in the Board's permit. (Smith-Florida)
W70-03191

MUNICIPAL CORPORATIONS.
Ohio Rev Code Ann secs 743.17, 743.25, 743.39 (Page 1953).

Descriptors: *Ohio, *Water works, *Water pollution, *Eminent domain, Legislation, Local governments, Cities, Public utilities, Pollutants, Streams, Water pollution control, Toxins, Construction, Dams, Canals, Water conveyance, Projects, Surveys, Maintenance, On-site investigations, Condemnation, Right-of-way, Domestic water, Pollution abatement.
Identifiers: *Raceways.

A municipal corporation whose water works territory is contiguous to another municipal corporation's territory may establish and maintain an advisable portion of its water works within the limits of the other municipal corporation. The pollution of a running stream used as a domestic water source by a municipal corporation is prohibited. A municipal corporation may enter upon private land to examine and survey for the purposes of building dams, canals, locks, and raceways, or transporting water. The municipal corporation has the right of eminent domain in connection with the public service enterprises. (Powell-Florida)
W70-03206

3F. Conservation in Agriculture

MAJOR USES OF LAND AND WATER IN THE UNITED STATES WITH SPECIAL REFERENCE TO AGRICULTURE-SUMMARY FOR 1964,
Agricultural Research Service, Washington, D.C.
For primary bibliographic entry see Field 06D.
W70-02891

GENERAL ECONOMIC ASPECTS OF UTILIZATION OF UNDERGROUND WATER FOR IRRIGATION IN HIGH PLAINS OF TEXAS,
Vernon T. Clover.
Department of Economics, Texas Technical College, Lubbock, 1961. 147 p.

Descriptors: *Economics, *Irrigation, Texas, Climate, Geology, Playas, Lakes, Recharge, Conservation, Value, Prices, Income, Taxes.
Identifiers: *Underground water, High Plains, Geography, Economic indicators, Land values.

The purpose of this study was two-fold: (1) to bring together the economically significant facts concerning the use of underground water for irrigation in the High Plains of Texas, and (2) to discover and analyze the general economic implications of these conditions. Chapter 6 of this study provides five indicators of the economic value of underground water. They are: (1) the relationship between land values and the prevalence of irrigation; (2) the relative dependence of farmers upon irrigation as indicated by (a) the percentage of farm land irrigated, and (b) the percentage that irrigated acreage was of harvested acreage; (3) the difference between the market prices of irrigated and dryland farms; (4) the differences between dryland and irrigated farms in regard to yields and the amount of net return to land and management; and (5) the relationship between the percentage of farm land irrigated and the dollar sales per acre. (Loeb-Rutgers)
W70-03010

LAND AND WATER DEVELOPMENT IN SOUTHERN FRANCE,
National Co. for the Management of the Lower Rhone and Languedoc Region.
P. Lamour.
In: Comparisons in Resource Management, Baltimore, Johns Hopkins Press, 1961, p 227-250, 34 p, 1 map.

Descriptors: *Agriculture, *Water resources development, *Irrigation, *Economics, Canals, Industries, Economic impact, Water use, Transportation, Navigation, Waterways, Rainfall, Rivers, Flooding, Dams.
Identifiers: *Rhone-Languedoc, *Economic balance, *Power generation, Public utility works.

This article deals with the efforts to improve the use of land and water resources in the Lower Rhone-Languedoc area of Southern France during the past ten years. These efforts are designed to bring a balanced renewal of all economic and social activities to this area and to bring income stability and job opportunities to its inhabitants. The main effort of the development program is an irrigation works system, which was proposed and started in 1957, and which should be concluded around 1980. This irrigation system permits a rapid and spectacular improvement both in agriculture and industry and is drawing many individuals to the area. The development has brought about the disappearance of the 'French desert areas,' and has generated significant economic and social growth in the region. The policies of this program may prove relevant to similar water problems and conditions in the United States. (See Vol. 2, No. 24, Field 6B, entry W69-09952). (Murphy-Rutgers)
W70-03023

SUBSURFACE IRRIGATION RESEARCH IN ARKANSAS,
Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering.
John P. Hoskyn, and Billy B. Bryan.
Available from the Clearinghouse as PB-189 081, $3.00 in paper copy, $0.65 in microfiche. Water Resources Research Center Publication No 3, Arkansas University Experiment Station Report Series 179, June 1969. 28 p, 12 fig, 5 tab, 15 ref. OWRR Proj No A-002-ARK.

Descriptors: *Irrigation, *Irrigation systems, *Subsurface irrigation, *Application equipment, Irrigation design, Equipment, Laboratory tests, On-site tests, Pipes.
Identifiers: Plastic pipe, Pipe perforating techniques.

Subsurface irrigation of cotton was studied to determine and evaluate the hydraulic problems in distributing water in small-diameter perforated plastic pipe at low pressures and to develop optimum design criteria. A greenhouse study of a subirrigation system indicated that 2 psi should be considered as a lower-limit pressure when orifices are built into the pipe wall. A placement depth of 12 inches was preferable to 18 inches in terms of the amount of water required. Twelve inches was used as the depth of placement for a field subirrigation system. From the standpoint of seasonal soil moisture levels and from observations of the system in operation, the following conclusions are drawn: (1) a pressure head of 6 feet of water is preferable to 10 feet, (2) 38-inch lateral spacing is preferred over 76-inch spacing, and (3) an orifice spacing of 30 inches is preferable to a spacing of either 12 or 48 inches. Internal plugging of orifices because of poor quality water was evident. A sufficient selection of valves, timers, engine motor controllers, etc., is already commercially available. (Knapp-USGS)
W70-03063

PROBLEM OF ALLOWING FOR THE INFLUENCE OF AGRICULTURAL MELIORATION PRACTICES ON FLOW IN THE CONSTRUCTION OF A GENERAL PLAN FOR THE UTILIZATION AND PROTECTION OF THE WATER RESOURCES OF THE USSR,
For primary bibliographic entry see Field 04C.
W70-03110

EVAPORATION WATER LOSSES UNDER SPRINKLING IRRIGATION CONDITIONS (RUSSIAN),
All-Union Research Inst. for Water Engineering and Reclamation, Moscow (USSR).
For primary bibliographic entry see Field 02D.
W70-03121

FROM MECHANIZATION TO AUTOMATION OF FARM CROP IRRIGATION PROCESS, (RUSSIAN),
All-Union Research Inst. for Water Engineering and Reclamation, Moscow (USSR).
N. I. Rabinovich.
Gidrotekhnika i Melioratsiya, No 8, p 31-36, Aug 1969. 2 fig, 2 tab, 1 ref.

Descriptors: *Farm management, *Crop production, *Irrigation practices, *Irrigated land, *Mechanical control, *Automation, Sprinkler irrigation, Productivity, Personnel, Statistics, Cost analysis.
Identifiers: *USSR, Irrigation process automation.

A statistical study of the devices and sprinkling systems used for the irrigation of farm lands in the USSR is described. Their technical and economic characteristics are discussed and a detailed table shows costs associated with introduction and construction of automated sprinkling systems, on the basis of the experience gained during their construction and operation at 5 agricultural sites of the USSR. (Gabriel-USGS)
W70-03122

SPRINKLING IRRIGATION ON LIGHT CHESTNUT SOILS IN THE VOLGOGRAD REGION (RUSSIAN),
G. E. Listopad, and G. I. Chizhikov.
Gidrotekhnika i Melioratsiya, No 8, p 44-46, Aug 1969. 3 fig, 2 tab.

Descriptors: *Sprinkler irrigation, *Chestnut soils, *Application equipment, Crops, Crop response, Parametric hydrology, Runoff, Soil density, Statistics, Evaporation.
Identifiers: *USSR, Volgograd region.

The effects of continuous and discrete sprinkling, sprinkling intensity, and the speed of motion of a sprinkling device on chestnut soils of the Volgograd region were experimentally investigated. In irrigation of the chestnut soils of the Volgograd region, the intensity of continuous sprinkling irrigation should not exceed 0.2 to 0.4 mm/min. In using discrete sprinkling, this rate can be considerably increased (up to 3 times). Higher speed of motion of sprinkling devices leads to higher productivity. (Gabriel-USGS)
W70-03123

COMPUTER SIMULATION PROGRAMMING: AN AID TO THE SELECTION AND MANAGEMENT OF CENTER PIVOT SPRINKLER SYSTEMS,
North Dakota State Univ., Fargo. Dept. of Agricultural Engineering.
E. C. Stegman, and A. Bauer.
Available from the Clearinghouse as PB-189 079, $3.00 in paper copy, $0.65 in microfiche. C.S.A.E. Conference Report, Saskatoon, Saskatchewan, Aug 1969. 31 p, 5 fig, 2 tab, 3 append. OWRR Project B-007-NDAK.

Descriptors: *Simulation analysis, *Sprinkler irrigation, *Management, *Design, *Input-output analysis, Droughts, Planning, Economic feasibility, Crop production, Soils, Water balance.
Identifiers: Center pivot sprinkler.

A computer simulation model was developed for a center pivot sprinkler irrigation system. The objective of the study was to simulate the operating characteristics of the center pivot sprinkler system which would permit the imposition of management scheme variations and offer improved methods of analyzing the suitability of designs for specific applications. The simulation program included (a) the definition of input variables, (b) water balance computations (c) 'when' to irrigate determination (d) 'which' field to irrigate determination, (e) drought day, stress period and yield potential evaluations, (f) yearly summary computation and (g) long record summary. The simulation program was applied to several selected combinations of soils and crop rotations in North Dakota. The data obtained in the study provided the planner with a base on which to estimate the physical adequacy, operational practicality and economic potential associated with a particular design. (Thiuri-Cornell)
W70-03162

CONSERVANCY DISTRICTS--IRRIGATION DISTRICTS.

Ohio Rev Code Ann sec 6101.73 (Page 1953).

Descriptors: *Ohio, *Irrigation districts, *Regulation, *Irrigation permits, Legal aspects, Flood protection, State governments, Legislation, Permits, Project planning, Irrigation programs, Condemnation, Drainage, Drainage systems, Compensation, Water rights, Flow.

The formation of irrigation districts is authorized and shall be organized by the court. Such court shall require proof that the organization and operation of the irrigation district will not interfere with any works or plans for flood prevention or the drainage of lands, or materially diminish their protective value. The deprivation of land lying upon any stream or the deprivation of the ordinary flow of water in such stream shall cause the owners thereof to be duly compensated if caused by the operation of the district. Taxes shall be levied and bonds issued as provided by this act and the power of the board of directors, as conferred generally by this act, shall stand subject to this section. (Barnett-Florida)
W70-03208

PREDICTION OF FLOW RESISTANCE IN FURROWS FROM SOIL ROUGHNESS,
Colorado Agricultural Experiment Station, Ft. Collins.
D. F. Heermann, R. J. Wenstrom, and N. A. Evans.
American Society of Agricultural Engineers, Transactions, Vol 12, No 4, p 482-485, 489, 1969. 1 tab, 2 fig, 6 ref.

Descriptors: *Furrow irrigation, *Irrigation efficiency, *Flow resistance, *Roughness coefficient, *Agricultural engineering, Irrigation, Infiltration, Energy gradient, On-site investigations, Colorado, Statistical methods, Soil physical properties, Roughness (Hydraulic), Resistance, Equations, Surface irrigation, Data collections, Model studies, Stochastic processes.
Identifiers: *Resistance coefficient, *Water advance rate, *Water recession rate, *Soil roughness.

Efficient surface irrigation is possible only with the proper combination of rates of water advance, and recession and thus, infiltration depth. Resistance to flow in furrows caused by surface roughness has an effect on all 3 factors. Studies of surface-roughness characteristics were carried out near Fort Collins and Grand Junction, Colorado. The field procedures are described in detail. The resistance coefficient is related empirically to the standard deviation of roughness height by an equation developed from laboratory observations. It was found that this relationship can be applied directly to field conditions for the range of discharges studied in rectangular and parabolic channels. In the field the standard deviation of roughness height was estimated with 6 randomly selected one-foot

records. It was found that for short furrow reaches (20 to 40 feet) the energy gradient could differ greatly from bottom slope. Therefore, caution must be used in predicting hydraulic variables with the bottom slope in place of energy gradient. On the other hand, for furrows of 140 feet or more, energy gradient can be replaced with bottom slope without serious errors in prediction. (Crouse-Arizona)
W70-03221

SOIL MOISTURE ON NATIVE GRAZING LANDS IN THE SEMIARID NORTHERN PLAINS OF USA,
Agricultural Research Service; and Montana Agricultural Experiment Station, Bozeman.
Walter R. Houston.
Annals of Arid Zone, Vol 7, No 2, p 230-234, 1968. 5 p, 2 tab, 1 fig, 4 ref.

Descriptors: *Soil moisture, *Semiarid climates, *Moisture stress, *Stocking, *Grazing, Soil properties, Soil compaction, Moisture availability, Livestock, Carrying capacity, Loam, Clays, Silts, Montana, Great Plains, Moisture stress.

The amount and duration of available soil moisture is critical for plants in arid and semiarid lands. A study of soil moisture conditions on 3 soils near Miles City, Montana was conducted. There was one range that had been heavily grazed for over 20 years and one only lightly grazed during that time. There were significant differences in soil moisture associated with intensity of grazing. Soil moisture was measured to 107 cm depth. During the favorable year soil moisture increased at 46 cm. and below in loam soil with heavy stocking, while there was less moisture accumulation with light stocking. Apparently there were more deeply rooted plants under light stocking. In contrast, on silty clay soil moisture accumulation at 76 cm. and below was greatly reduced under heavy grazing, probably due to soil sealing and compaction from livestock trampling. During the drought year the soil became dry under both conditions. Prolonged drought reduced forage production to the same level under both grazing conditions possibly owing to death of some plants in the lightly stocked range. (Crouse-Arizona)
W70-03222

THE DEVELOPMENT OF AN IRRIGATION BUDGET,
Department of Agriculture, Edmonston (Alberta). Water Resources Div.; and Saskatchewan Univ., Saskatoon. Dept. of Agricultural Engineering.
H. A. Kerr, and J. M. Murray.
Canadian Agricultural Engineering, Vol 10, No 1, p 12-16, 1968. 1 tab, 3 fig, 15 ref.

Descriptors: *Irrigation, *Irrigation efficiency, *Soil-water-plant relationships, *Soil moisture, *Moisture availability, Irrigation practices, Agriculture, Plant growth, Nuclear moisture meters, Moisture tension, Root zone, Wilting point, Field capacity, Moisture content, Arid lands, Semiarid climates, Atmometers, Evapotranspiration, Water balance, Estimating, Alfalfa, Bromegrass.
Identifiers: *Canada, *Irrigation budget, Saskatchewan.

In arid and semiarid lands irrigation is used to supplement rainfall so that agricultural crops will not be deprived of water required for proper development. An adequate yet efficient irrigation schedule is not possible without knowledge of water requirements of crops and soil moisture conditions. For 2 years soil moisture levels were measured under irrigated stands of alfalfa and brome grass in Saskatchewan, Canada, with a neutron gauge. Measured soil moisture in the top 4 feet of soil was compared with calculated soil moisture using Bellani plate atmometer readings. Soil moisture as predicted from calculated soil moisture budget closely paralleled measured soil moisture. The calculated moisture budget considered the effects of crop height, soil and plant rooting characteristics on the rate of soil moisture use, as well as the evaporation potential. The budget calculation technique is described and graphs are presented comparing measured and estimated soil moisture. (Crouse-Arizona)
W70-03223

PERFORMANCE OF TILE DRAINS UNDER IRRIGATION IN SOUTHERN ALBERTA,
Department of Agriculture, Lethbridge (Alberta); and Manitoba Univ., Winnipeg. Dept. of Agricultural Engineering.
E. Rapp, and G. E. Laliberte.
Canadian Agricultural Engineering, Vol 10, No 2, p 64-69, 1968. 2 tab, 6 fig, 11 ref.

Descriptors: *Irrigation, *Saline soils, *Saturated soils, *Drainage systems, *Tile drainage, Arid lands, Semiarid climates, Groundwater, Subsurface drainage, Drainage effects, Loam, Sands, Tiles, Irrigation engineering, Water table.
Identifiers: *Canada, Alberta.

In an arid environment where irrigation is necessary to agricultural production, tile drains are often used to prevent water logging and salinity or to reclaim soil that was originally saline. The proportion of water applied that must be handled by the drainage system will vary according to soil, water and climatic conditions. The study was conducted in southern Alberta to provide guide lines for designing irrigation drainage systems for that area. Five tile drain systems were tested in areas of sandy loam and loams over sand for a 12-year period. Two interceptor tile drain systems proved highly effective in removing excess water and salts. The performance of three relief tile drains was highly variable. Since salinity of the effluent from relief drains showed no decrease with time, they were judged doubtful for reclamation purposes although they did effectively remove excess water. If relief drains are to be used, the authors suggest that spacing should be no more than 700 to 800 feet to achieve greater effectiveness. (Crouse-Arizona)
W70-03227

COMMITTEE REPORT. SOIL SCIENCE IN RELATION TO WATER RESOURCES DEVELOPMENT: III. SOIL MOISTURE CONSERVATION.
Soil Science Society of America, Inc., Madison. Water Resources Committee.

Soil Science Society of America, Proceedings, Vol 33, No 3, p 480-482, 1969. 3 ref.

Descriptors: *Soil science, *Evapotranspiration, *Evaporation control, *Agriculture, *Water resources development, Soil moisture, Water loss, Soil surfaces, Stomata, Solutes, Mulching, Great Plains, Arid lands, Semiarid climates, Water conservation, Consumptive use, Water amanagement (Applied), Water utilization.

Though all plants require water for growth, some utilize moisture more efficiently than others. Rarely is more than 2% of the water consumed converted into usable products. An estimated 70% of annual precipitation in the U.S. is consumed in evapotranspiration. If only 10% of this could be conserved through more efficient plant use or soil surface conservation, the additional amount available for urban industrial use would be significant. Movement of water into and through soil is reviewed in this article and possible areas for conservation are indicated. Ideally, agriculture would remove from the soil only that moisture required for satisfactory plant development. Soil scientists are conducting studies such as stomatal control, fogging to reduce atmospheric demand, use of barriers against direct evaporation from the soil surface and use of water of higher solute content. Continued efforts of soil scientists can make more nonagricultural uses compatible with agricultural needs. (Crouse-Arizona)
W70-03230

RANGELAND DEVELOPMENT IN KENYA,
Ministry of Agriculture and Animal Husbandry, Nairobi (Kenya). Range Management Div
D. J. Pratt.
Annals of Arid Zone, Vol 7, No 2, p 179-208, 1968. 2 tab, 3 fig, 17 ref.

Descriptors: *Arid lands, *Range management, *Water resources development, *Rural sociology, *Long-term planning, Brush control, Carrying capacity, Grazing, Vegetation regrowth, Soil conservation, Water shortage, Land tenure, Water table, Social adjustment, Social impact, Economics, Economic feasibility, Management, Welfare (Economics), Ecology, Plant ecology, Wildlife, Grasslands, Population, Governments, Programs, Research and development, Tropical regions, Conservation.
Identifiers: *Kenya, *Pastoralism, East Africa.

In arid and semiarid grazing regions of Africa increased population and demand for food has placed tremendous pressure on the land. The indigenous population has attempted to use these dry lands according to traditional methods, thereby creating a major socioeconomic problem. An intricate approach toward this problem is being attempted in Kenya. The objective is to develop planning and management programs based on careful studies of the ecology, sociology, land tenure, and natural resources of the area. Each of these factors is reviewed in some detail with emphasis on the peculiarities of East Africa and Kenya in particular. It is concluded that a key to encouraging the social change necessary to changing subsistence pastoralism into commercial livestock production lies with establishment of secure tenancy to adequate management units. But land title should be given only when there is evidence that adequate water development, animal health, and sound management procedures are being followed. (Crouse-Arizona)
W70-03232

RECENT ADVANCEMENTS IN THE USE OF STANDARD CLIMATIC DATA FOR ESTIMATING SOIL MOISTURE,
Department of Agriculture, Ottawa (Ontario). Plant Research Inst.
For primary bibliographic entry see Field 02G.
W70-03233

DROUGHT HAZARDS TO SEED GERMINATION,
Nottingham Univ. (England). School of Agriculture.
Walter Heydecker.
Annals of Arid Zone, Vol 6, No 1, p 22-34, Mar 1967. 9 tab, 1 fig, 14 ref.

Descriptors: *Droughts, *Germination, *Soil moisture, *Moisture availability, *Seeds, Drought tolerance, Bulk density, Soil temperature, Soil types, Moisture stress, Field capacity, Planting management, Soil-water-plant relationships, Arid lands, Solutes, Salinity, Osmotic pressure, Plant physiology, Compacted soils, Crop response.
Identifiers: *Water potential, Seedlings.

Germination trials of researchers are reported in a discussion of effects of drought, high soil temperatures and salinity on seed germination. Not all of the studies reviewed were conducted in normally arid lands but the conditions are common to arid lands. The degree of drought under which seeds germinated varied substantially by species. Thus, cabbage and corn seeds could germinate under much drier conditions than onions, carrots, or lettuce. In many cases high temperatures such as are common in arid lands interacted with low soil moisture to further inhibit germination. From data presented it was also apparent that too much soil moisture might also suppress germination. Germination of cabbage and spinach, for example, was much higher at soil water potential of -1.0 atmospheres than under drier conditions or at field capacity. Germination was also better in loamy media with good moisture conductivity than in

media of lower bulk density with resulting poor moisture conductivity. This suggests desirability of compression of low bulk density soils to make more moisture available to germinating seeds. Crusting, however, should be avoided since this can mechanically interfere with successful emergence after germination has taken place. Osmotic potentials of salt solutions in the soil water can also impede germination of seeds in a manner similar to actual moisture stress. Finally, even if the seed does germinate there must be sufficient soil moisture to permit successful development of a root system if the seedling is to grow further. In general the information reported can be useful in developing successful irrigation practices in arid lands. (Crouse-Arizona)
W70-03234

LAND RECLAMATION AND IRRIGATION IN SOVIET AGRICULTURE: AZERBAIDZHAN LEADER REVIEWS LAND RECLAMATION,
V. Yu. Akhundov.
Translated from Bakinskiy rabochiy, Nov 19, 1968. p 3. Land Reclamation and Irrigation in Soviet Agriculture, Joint Publications Research Service, JPRS 47380, p 17-23, 1969.

Descriptors: *Land reclamation, *Irrigated lands, *Project planning, *Construction, *Coordination, Working conditions, Human resources, Salinity, Alkalinity, Gypsum, Arid lands, Soil conservation, Erosion control, Water quality, Water resources development.
Identifiers: *USSR, *Azerbaidzhan.

In 1965 some 162,000 of 1,278,000 hectares of irrigated land were not in production. Since then 11,100 hectares of new lands have been irrigated, others have improved water supplies and agricultural use of irrigated land is up to 97.1%. Productivity remains unsatisfactory. Salinity and alkalinity have become problems. In 1967 a plan called for applying gypsum to 21,800 hectares. Application was carried out on only 725 hectares. There is poor coordination among the several agencies involved in land reclamation and improvement. There is a shortage of skilled labor and technical personnel. Lack of adequate housing and cultural facilities in the newly developed lands also exists. There must be an improvement in determining and meeting completion dates and in the quality of construction on water control systems if agricultural productivity goals are to be met. There is a need for more careful consideration of economic efficiency in planning and executing irrigation and agricultural development projects. There is also a necessity for better forestry practices in the water source areas to protect them from erosion and decline in water quality. (Crouse-Arizona)
W70-03240

LAND RECLAMATION AND IRRIGATION IN SOVIET AGRICULTURE: TADZHIK PARTY LEADER REVIEWS ROLE OF IRRIGATION,
D. R. Rasulov.
Translated from Kommunist Tadzhikistana, Nov 20, 1968. p 2, 3. Land Reclamation and Irrigation in Soviet Agriculture, Joint Publications Research Service, JPRS 47380, p 7-10, 1969.

Descriptors: *Irrigation projects, *Working conditions, *Project planning, *Coordination, *Water resources development, Drainage systems, Arid lands, Irrigated land, Irrigation, Productivity, Labor supply, Investment, Rural areas, Urbanization, Management, Personnel, Land reclamation.
Identifiers: *USSR, *Tadzhikistan.

In Tadzhikistan, USSR, efforts to bring new arid land into cultivation with irrigation have been sharply reduced in effectiveness because of poor coordination between agencies. For example, some 24,000 hectares provided with irrigation in the Zafarobod area show low productivity because housing and cultural facilities were not provided for a potential labor force. In Yavan only 44% of the funds allocated for housing in 1968 was actually used. Major capital investments have been frozen in unproductive irrigation projects owing to lack of coordination between agencies. In several locations productive irrigated land is being encroached upon by urban sprawl. An estimated 70,000 hectares are nonproductive because of lack of drainage systems. A new agency-the Ministry of Rural Construction-has been organized to provide needed housing, roads and community buildings. However, it is slow in attacking the problem because of substandard quality construction and lack of skilled personnel. Full scale reform and a systematic approach to rural development is necessary. (Crouse-Arizona)
W70-03241

LAND RECLAMATION AND IRRIGATION IN SOVIET AGRICULTURE: TURKMEN PARTY LEADER OUTLINES IRRIGATION PLANS,
B. Ovezov.
Translated from Turkmenskaya iskra, Nov 29, 1968. p 1, 3. Land Reclamation and Irrigation in Soviet Agriculture, Joint Publications Research Service, JPRS 47380, p 11-16, 1969.

Descriptors: *Land reclamation, *Irrigation projects, *Working conditions, *Project planning, *Salinity, Drainage, Rural areas, Irrigation canals, Irrigated land, Land development, Soil conservation, Erosion, Drainage systems, Irrigation practices, Arid lands, Agriculture, Planning, Land forming.
Identifiers: *USSR, *Turkmenistan, Karakum Canal, Land leveling.

During 1966-1967 more than 2 million hectares were newly irrigated and drained throughout Turkmenistan, USSR. Reclamation has become a major part of agricultural activity there. Productivity has greatly increased on the collectives. Technical personnel with higher education increased from 2,100 in 1963 to 3,400 in 1968. Capital construction increased by 67%. In Turkmenistan improved irrigated land increased by 110,000 hectares. Construction of the Karakum Canal has continued until it now irrigates some 210,000 hectares including 140,000 of virgin lands. Drainage systems have been improved with 3,200 km. of collectors built. Some areas are still unproductive due to salinity and erosion. The current five-year plan calls for 90,000 additional hectares of irrigated land, improved irrigation practices on 200,000 hectares and leveling of 300,000 hectares. Current planning for the Karakum Canal scheme calls for a total of 600,000 hectares of irrigated land by 1980. For this plan to be successful, there must be increased construction of housing and other improvements in rural working conditions. (Crouse-Arizona)
W70-03242

LAND RECLAMATION AND IRRIGATION IN SOVIET AGRICULTURE: KIRGIZ PARTY LEADER DISCUSSES IRRIGATION PROBLEMS,
T. V. Usubaliyev.
Translated from Sovetskaya Kirgiziya, Nov 27, 1968. p 2, 3. Land Reclamation and Irrigation in Soviet Agriculture, Joint Publications Research Service, JPRS 47380, p 1-6, 1969.

Descriptors: *Land reclamation, *Irrigated land, *Irrigation operation and maintenance, *Productivity, *Alkalinity, Saturated soils, Salinity, Irrigation efficiency, Irrigation practices, Economic efficiency, Leaching, Water conveyance, Water loss, Water management (Applied), Grazing, Range management, Labor supply, Agriculture, Land forming.
Identifiers: *USSR, *Kirgiz, Land leveling.

Irrigation problems in Kirgiz are discussed. Work on irrigation has been done, but many of the areas with irrigation water supply have low productivity. More than 4 million hectares are in poor condition due to water logging, salinity, alkalinity and stony conditions. Millions of rubles worth of production are lost yearly to saline conditions. The new five-year plan calls for new and improved drainage systems, improvement of existing irrigations systems, and extensive land leveling. Total irrigated land will increase by 19,000 hectares and 61,000 hectares of grazing land will be provided with water. The irrigation water supply to 100,000 hectares will be increased and 28,000 hectares will be leveled. These plans will require improved efficiency in water development organizations and more effective investment planning. One-half of the water supply is lost in transfer through poorly built or maintained irrigation systems. Part of the trouble is caused by poor coordination among agencies and poor working and living conditions for labor. (Crouse-Arizona)
W70-03243

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

FLOOD PLAIN INFORMATION, AMERICAN FORK AND DRY CREEK, AMERICAN FORK AND LEHI, UTAH.
Corps of Engineers, Sacramento, Calif.

Prepared for Utah Div of Water Resources and Utah County. Corps Engineers Flood Plain Report, Nov 1969. 29 p, 15 fig, 8 plate, 8 tab.

Descriptors: *Floods, *Flood damage, *Utah, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: *American Fork (Utah), Lehi (Utah), Standard project flood, Intermediate regional flood.

Flooding of the American Fork and Dry Creek, Lehi, Utah is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-02866

THE EFFECTS OF THE W. A. C. BENNETT DAM ON DOWNSTREAM LEVELS AND FLOWS,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
A. Coulson, and R. J. Adamcyk.
Inland Waters Branch Technical Bulletin No 18, Department of Energy, Mines and Resources, 1969. 9 p, 2 fig, 3 tab.

Descriptors: *Streamflow forecasting, *Reservoir operation, *Regulated flow, Dams, Reservoir storage, Hydroelectric plants, River flow, Low flow.
Identifiers: *Canada, British Columbia, Peace River, Bennett Dam.

The effects on the flow of the Peace River, British Columbia, caused by construction and operation of the W.A.C. Bennett dam are summarized using limited stream flow and water level data. Probabilities of high and low flows to be expected with dam regulation are tabulated. (Knapp-USGS)
W70-02877

FORECASTING THE RHINE RIVER DISCHARGES (FRENCH),
Electricite de France, Grenoble. General Technical Div.
For primary bibliographic entry see Field 02E.

W70-02884

A STUDY OF DRAINAGE CONDITIONS ON A HILLSIDE RECEIVING SEWAGE PLANT WASTE WATER EFFLUENT AT WEEKLY INTERVALS,
Pennsylvania State Univ., University Park. Dept. of Agronomy.
For primary bibliographic entry see Field 05E.
W70-02893

MISSISSIPPI WATER RIGHTS LAW,
For primary bibliographic entry see Field 06E.
W70-02897

THE LAW OF UNDERGROUND WATER; A HALF-CENTURY OF HUBER V MERKEL (NON-STATUTORY RULES),
David L. Uelmen.
Wis L Rev, Vol 1953, No 3, p 491-503, May 1953.

Descriptors: *Reasonable use, *Subsurface waters, *Water law, *Underground streams, Riparian rights, Prior appropriation, Groundwater, Hydrologic cycle, History, Percolating water, Judicial decisions, Water policy, Water resources, Artificial use, Competing uses, Legal aspects, Natural use, Ownership of beds, Administrative decisions, Water allocation, Usufructuary right.

While the law regarding surface water is well settled along the lines of reasonable use and rights of riparian owners, the law of underground waters is not as well defined. Three groups of non-statutory rules exist today. The English common law rule is that percolating water existing in the earth is regarded as a part of the soil in which the person owning the land has a property right. This principle is based upon the maxim, to whomsoever the soil belongs, he owns also the sky and to the depths. Early American decisions followed this rule. In later cases, the reasonable use or American rule was developed. When the absolute water rights of one owner conflict with the absolute water rights of another, the person causing the injury must show a reasonable use in connection with the land from which the water is taken and a lack of malice. The California or correlative rights, rule recognizes situations where both land owners want to use the water reasonably on their land, and the supply is insufficient. Here, apportionment of the water provides a solution. (See W70-02898). (Schram-Florida)
W70-02899

CONSTITUTIONAL LAW--NAVIGABLE WATERS--EXTENSION OF THE FEDERAL PEROGATIVE,
Orton Alan Jones.
W Va L Rev, Vol 63, No 1, p 59-62, Dec 1960. 4 p.

Descriptors: *Navigable waters, *Tributaries, *Federal-state water rights conflicts, *Judicial decisions, Federal government, State governments, Regulation, Eminent domain, Watershed management, Flood control, Hydroelectric power, Admiralty, Water law, Federal jurisdiction, Non-navigable waters.
Identifiers: Commerce power.

United States v Grand River Dam Authority, 80 S Ct 1134 (1960), held that Congress may, under the commerce clause, regulate the water flow of a navigable stream. When it does so, there is no taking of property within the meaning of the Fifth Amendment. Under the commerce power, Congress can treat watersheds on navigable streams and their tributaries, and on non-navigable tributaries of navigable streams, as vital to flood control, and can thereby subject them to federal control. The original rule that federal control of interstate commerce extends to all public navigable lakes and rivers has been expanded by the courts to allow federal control to extend over non-navigable portions of navigable streams, and even over intrastate waterways, if such waterways are part of a continuous interstate system. The instant case permits federal control over not only non-navigable portions of a navigable stream, but also non-navigable tributaries of a navigable stream. The trend is toward a rule that would afford the federal government potential control over all the streams in the country that could be classified as being within the watershed of a navigable waterway. (Barnett-Florida)
W70-02902

NAVIGABILITY AS APPLIED TO LAKES IN LOUISIANA.

La L Rev, Vol 6, No 4, p 698-706, May 1946. 9 p, 28 ref.

Descriptors: *Louisiana, *Lakes, *Riparian rights, *Navigable waters, Judicial decisions, Lake beds, Beds, Dry beds, Beds under water, Lake shores, Riparian land, Ownership of beds, Riparian waters, Riparian water loss, Navigation, Bodies of water, Non-navigable waters, Water policy, Accretion (Legal aspects), Boundaries (Property), State governments.

The scope of the laws of alluvion and dereliction and the rights of riparian owners generally do not extend to lakes. According to public policy, the bed of a navigable lake belongs to the state since ownership of the banks by private individuals would practically preclude navigation. The courts have found Articles 509 and 510 of the Civil Code to be inapplicable to lakes, although the proper classification of waterbodies continues to be a source of litigation. A 1910 act provides that beds of lakes not under private ownership are the property of the state, so riparian claims as to non-navigable lakes are against state owned land. Therefore, riparian owners have no claim to the dry bed of a non-navigable lake, since it is either under direct private ownership or is owned by the state. The definition of navigability is not based on whether the body of water has been navigated in the past, but whether it is in fact available for commerce. The burden of proof is on the party who claims that the body of water is navigable. (Douberley-Florida)
W70-02906

NAVIGABLE WATERS, HARBORS AND NAVIGATION.
Wis Stat Ann secs 30.01-30.06 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Navigable waters, *Public rights, *Bulkhead line, Legislation, Legal aspects, Resource development, Cities, Transportation, Docks, Piers, Basins, Bulkheads, Beds, Lake Michigan, Administrative agencies, Federal jurisdiction, State jurisdiction, Shores, Regulation, Control, Remedies, United States.
Identifiers: *Harbor facilities, *Dock line, Ferries.

A number of terms are defined, including harbor facility, pier, and wharf. Harbor facility means every facility which is useful in the maintenance or operation of a harbor. Pier means any structure which extends channelward from the shore with water on both sides and which is used to moor or unload watercraft. Wharf means any structure which extends along the shore and which is used to moor or unload watercraft. Whenever there is a violation of the statutes relating to navigable waters or an infringement of public rights therein which the Department of Resource Development believes will not be adequately remedied by imposition of penalty, the Department may order the parties responsible to abate the violation. If the Department's order of abatement is ineffective, the attorney general will institute proceedings for enforcement of the Department's order. A shore line established prior to January 1, 1960 is deemed to be a bulkhead line subsequent to such date; a dock line established prior to such date is deemed to be a pierhead line subsequent to such date. None of the foregoing provisions are applicable to submerged shore lands in Lake Michigan owned by municipalities. The Department may waive the applicability of the foregoing provisions as they relate to navigable waters falling within the concurrent jurisdiction of the United States. (Keith-Florida)
W70-02907

HARBORS AND NAVIGATION.

Wis Stat Ann secs 30.30-30.35 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Water resources development, *Harbors, *Shore protection, Legislation, Legal aspects, Navigable waters, Cities, Canals, Watercourses (Legal), Navigation, Construction, Maintenance, Administrative agencies, Leases, Comdemnation, Contracts, Regulation, Federal government, Flood control, Dredging, Financing, Riparian land, Riparian rights, Bonding, Railroads.
Identifiers: *Harbor improvement.

Every city having navigable waters within or adjoining its boundaries is authorized to: (1) construct, maintain, and improve harbor facilities; (2) construct and maintain shore protection walls; (3) acquire land by condemnation and make special assessments to carry out the foregoing provisions; (4) cooperate with the federal government in the latter's harbor improvement projects; and (5) lease the wharfing privileges of navigable waters at the ends of streets. The procedural and public policy considerations by which cities are to be guided in carrying out the foregoing powers are set forth. Statutory guidelines are provided for the letting of contracts by cities for the construction, maintenance and improvement of harbor facilities and shore protection walls. Any city operating a public harbor through a board of harbor commissioners may construct, maintain, and operate railway facilities connecting various harbor facilities with one another or with other railroads in the vicinity of the city. Provision is made for the financing of shore protection walls and harbor facilities. (Keith-Florida)
W70-02908

HARBORS AND NAVIGATION.

Wis Stat Ann secs 30.77-30.90 (1964).

Descriptors: *Wisconsin, *Boating regulation, *Local governments, *Legislation, Administrative agencies, Boats, Cities, Permits, Boating, Marinas, Boat-launching ramps, Inspection, Aircraft, Financing, Safety, Navigable waters, Public health, Iced lakes, Lakes, Access routes, Recreation facilities, Water pollution.
Identifiers: *Enforcement, *Commercial boating, *Sea planes.

Except as otherwise provided, no municipality may regulate boats or exclude them from the free use of the waters of the state. However, municipalities may adopt regulations relative to the equipment and use of boats consistent with this chapter. Municipalities bordering on inland lakes may regulate the use of boats on those lakes provided all municipalities bordering such lakes have enacted identical regulations. Municipalities may charge fees for using municipally owned launching facilities and may regulate boats carrying passengers for hire. All local regulations must be published. Municipalities may regulate the operation of sea planes on the surface of waters adjoining such municipalities. The state shall give financial aid to municipalities for local enforcement of this chapter by water safety patrol units. The Conservation Commission may establish the jurisdiction of local enforcement units. Such units shall have the enforcement powers of a sheriff. Penalties are provided for violations of this statute. Municipalities may regulate the operation of boats and vehicles on icebound inland lakes. Such regulation shall not render any municipality liable for accidents on regulated lakes. No public access may interfere

with the use of Lions Lake as a recreational area for the physically handicapped. (Dearing-Florida)
W70-02910

DAMS AND BRIDGES.

Wis Stat Ann secs 31.30-31.35 (1967), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Administrative agencies, *Dams, *Water levels, Mills, Mill dams, Non-navigable waters, Wildlife conservation, Fish passages, Water control, Flow, Rivers, Streams, Lakes, Ponds, Cranberries, Crops, Compensation, Damages, Licenses, Leases, Regulation, Discharge, Trout, Fish management, Conservation, Marshes, Damsites, Dam construction, Natural flow, Obstruction to flow, Regulated flow.
Identifiers: *Penalties (Civil).

With the exception of three specified sites or other sites chosen by the Conservation Commission and the Department of Resource Development, no dams shall be constructed across the Brule River and its tributaries. Such dams are to have adequate fishways for the conservation of trout. Water mills and dams may be erected and maintained on streams non-navigable in fact in accordance with delineated regulations. Municipalities may exercise the same rights upon such streams as upon ones navigable for any purpose. Construction of dams to the injury of any lawfully constructed mill is prohibited. All mills and milldams lawfully constructed on non-navigable streams are subject to regulation by the Department of Resource Development, except that no regulation shall prohibit any owner of flooded land from recovering full compensation for his damages. Licenses are hereby issued to the owners of any milldams. The Department may regulate water levels controlled by such milldams. Persons maintaining dams on navigable streams shall pass at least twenty-five percent of the natural flow at all times. Civil penalties are provided for violations. Dams shall not be operated so as to endanger the water supply to cranberry marshes. (Duss-Florida)
W70-02911

WATER RESERVOIRS - RIVER IMPROVEMENT CORPORATIONS.

Wis Stat Ann secs 182.005, 182.016 (1957).

Descriptors: *Wisconsin, *Reservoirs, *Rivers, *Reservoir sites, Legislation, Legal aspects, Water resources, Flow, Flow control, Streams, Dams, Electric power, Local governments, Cities, Land use, Ponds, Bodies of water, Public benefits, Alteration of flow, Regulation, Regulated flow.

The articles of a corporation organized to maintain a system of water reservoirs to regulate the flow of any river must guarantee to owners of water power located below the reservoir system the right to purchase capital stock of the corporation. Corporations' articles may not be amended to withdraw the guaranty. Corporations, private and municipal, may acquire lands necessary for use for ponds or reservoirs if engaged in river improvement activities or furnishing electric power for public purposes. (Casey-Florida)
W70-02915

MUNICIPAL COOPERATION IN FEDERAL RIVERS, HARBORS OR WATER RESOURCES PROJECTS.
Wis Stat Ann sec 66.45 (1965).

Descriptors: *Wisconsin, *Cities, *Federal government, *Water resources development, Legislation, Federal jurisdiction, Rivers, Harbors, Navigation, Cost allocation, Construction, Maintenance, Navigable waters, Control, State governments, Administrative agencies, Project purposes, Projects.

Any county, town, city, or village may agree to cooperate with an agency of the federal government in the construction, operation, or maintenance of any federally authorized projects related to rivers, harbors, or water resources management. If more than one municipality is affected, they may agree to act jointly and may submit any determinations of cost allocation or division of responsibilities among themselves to an arbitration board. (Casey-Florida)
W70-02916

ENLARGEMENT, CONSOLIDATION, DIVISION AND DISSOLUTION OF DRAINAGE DISTRICT.
Wis Stat Ann secs 88.77-88.83 (Supp 1969).

Descriptors: *Wisconsin, *Drainage districts, *Drainage, *Administrative agencies, Drainage programs, Drainage systems, Cost sharing, Local governments, Water policy, Institutions, Decision making, Management, Drains, Cities, Legislation, Legal aspects, Control.

Owners of lands adjacent to a drainage district may petition for annexation to that district. Rules governing procedure for such annexation are provided. Lands receiving benefits from a district may be annexed. Public hearings may result in the consolidation of districts. A landowner may withdraw from a district only where no material injury to the remainder of the district will result. Rules are provided for such withdrawal for the suspension of district operations and for the dissolution of districts on petition of landowners. All debts incurred by a district must be paid before the dissolution of the district. District drains become common waterways subsequent to dissolution. Control of a district within a city may, on petition, be transferred to the city. Requirements and procedure for transfer of control are provided. Transfer may be initiated by landowners or by the city. Money assessed against land in the district is transferred to the city when control over the district is transferred. (Dye-Florida)
W70-02922

NAVIGATION COMMISSION FOR THE DELAWARE RIVER.
Pa Stat Ann tit 55, secs 1-16 (1964).

Descriptors: *Pennsylvania, *River regulation, *Permits, *Administrative agencies, Legislation, Planning, Navigable rivers, Governments, Administration, Building codes, Construction, Zoning, Legal aspects, Surveys, Delaware River, Rates, Regulation, Bridge construction, Harbors, Docks, Maintenance, Cleaning.
Identifiers: Licenses, Penalties (Civil).

An appointive administrative commission is created and is to be known as the Navigation Commission for the Delaware River. The Commission's powers are to survey the capacity of the Delaware River and its tributaries for commercial purposes, regulate construction, and adopt and promulgate regulations for construction on the River. It is the duty of the President of the Commission to enforce these regulations, and failure to comply with such regulations is a misdemeanor punishable by fine. Upon application to the Commission, a license to construct any bridge or harbor structure is issued subject to a hearing and approval of plans and specifications and subject to further approval of the Water and Power Resources Board. The license is void unless work is begun within six months after issuance. All structures not in compliance with law are a public nuisance. The Commission may place liens upon docks, with notice, for having the docks cleaned when such docks are not properly maintained by the owners. The Commission regulates rates for dockage and makes annual statements of expenses. All decisions of the Commission are appealable to the court of common pleas. (Barnett-Florida)
W70-02924

WIDENING OF STREAMS.

Pa Stat Ann tit 55, secs 261 thru 265 (1964).

Descriptors: *Pennsylvania, *Stream improvement, *Channel improvement, *Ownership of beds, Streambeds, Legislation, Navigable waters, Tides, Highways, Transportation, Width, Depth, Channel morphology, Length, Riparian land, Riparian rights, Navigation, Legal aspects, Cost-benefit ratio, Cost allocation.

The county courts may authorize the widening, deepening, and straightening of all navigable streams affected by ocean tides when both sides of the stream are within Pennsylvania. All laws of the Commonwealth relating to widening and straightening roads and highways are applicable to the widening, deepening, and straightening of these navigable streams. The expenses for the improvements must be borne by the advantaged landowners whose lands border on these streams. When such improvements cause any part of the bed of a stream to be left vacant, title to such bed vests in the adjoining landowner. An application to the court by the owners of two-thirds of the land bordering on a stream is required to make improvements authorized by this statute. All of the owners of land through which the stream passes are directed to make improvements ordered by the courts upon approval of a petition. After the improvements are made, the court is required to confirm and establish the altered stream as a navigable stream and public highway, and to vacate that part of the original stream which may have been rendered useless. (Schram-Florida)
W70-02925

HARBOR OF ERIE.
Pa Stat Ann tit 55, secs 361-363, 368-369, 372-374 (1964).

Descriptors: *Pennsylvania, *Harbors, *Port authorities, *Cities, Leases, Marinas, Dredging, Channel improvement, Bridge construction, Boats, Boating regulations, Docks, Water pollution, Soil contamination, Wildlife conservation, Parks, Forests, State governments, Regulation, Ponds, Lagoons, Encroachment, Public benefits.
Identifiers: *Canal basins.

The State Park and Harbor Commission of Erie has full power to maintain and develop all dedicated lands for the purpose of improving the harbor of Erie. The Commission may: (1) contract for the planning, engineering, dredging, filling, bridging, and erection of docks; (2) grant reasonable leases and concessions for the establishment of a suitable harbor for yachts; (3) control waterways, ponds, lagoons, and the operation of boats, docks, and landings; (4) prevent encroachment on lands, channels, and shores of Presque Isle Peninsula; (5) prevent pollution of land or waters; and (6) enact rules for the protection of wildlife. The state dedicates the Presque Island Peninsula to the use of the public. The Erie city authorities may regulate the manner in which the canal basins may be used by the public. The Department of Forests and Waters shall convey to the city of Erie the canal basins and the water property in the Bay of Presque Isle. The water property conveyed is controlled by the city of Erie for the development of the Port of Erie. (Schram-Florida)
W70-02928

WHARVES AND DOCKS.

Pa Stat Ann tit 53, sec 16831, 16834, 16836-16840, 16843 (1957).

Descriptors: *Pennsylvania, *Docks, *Low water mark, *Port authorities, Legislation, Construction, Erection, Riparian land, Riparian waters, Banks, Administrative agencies, Administrative decisions, Permits, Piers, Coastal structures, Rivers, Delaware River, Harbors, Channels, Boundaries (Property), Riparian rights.
Identifiers: *Wharf lines.

The waters in rivers outside of the low water mark are the property of the Commonwealth. No owner of land inside of said mark shall erect or extend any wharf in the Port of Philadelphia without first obtaining a license from the Board of Wardens of the port. Riparian owners of land dedicated to public use are deemed owners of land inside the low water mark. The breadth of water front appertaining to adjacent landowners is determined by protracting the lines of the land to the established wharf limit except when this would give the owner more, or any other property owner less, than his proportionate share of frontage on the wharf line. The procedure for establishing wharf lines on the Schuylkill River is outlined, and once established, no wharf shall be extended further into the river than such lines. In making surveys and soundings for such lines, the surveyors may enter upon any land adjoining the Schuylkill. The Wardens of the Port of Philadelphia may determine the extent to which wharves may be built into the Schuylkill. Any person desiring to erect or extend a wharf into the tide-way of the Delaware River must apply to the Board of Wardens. A license will be granted if the wharf will not encroach on or injure the channel or harbor. (Schram-Florida)
W70-02930

APPROPRIATION OF STREAMS FOR WATER SUPPLY.

Pa Stat Ann tit 53, sec 2905 (1957).

Descriptors: *Pennsylvania, *Water works, *Water conveyance, *Water supply, Legislation, Streams, Rivers, Easements, Right-of-way, Highways, Railroads, Local governments, Bridges, Farms, Erection, Construction, Appropriation, Cities, Pipelines, Water transfer.

Any city desiring to erect waterworks or improve its water supply may appropriate springs, streams, lands, easements, and rights of way, whether within its territorial limits or not. Any city may also lay pipes across, over, or under any lands, rivers, bridges, highways, and railroads to conduct water obtained outside of its territorial limits. However, no waters or springs shall be used so as to deprive the owner thereof of the free use and enjoyment of them for any domestic or farm purposes. (Schram-Florida)
W70-02931

BRIDGES, VIADUCTS AND CULVERTS.
Pa Stat Ann tit 16, secs 2601, 2630-2631, 2652 (1956).

Descriptors: *Pennsylvania, *Culverts, *Bridges, *Embankments, Dikes, Banks, Legislation, Highways, Local governments, Construction, Bridge construction, Abutments, Piers, Streams, Routing, Railroads, Canals, Engineering structures, Stream improvement, Floods, Transportation.
Identifiers: *Altering course of streams.

The county commissioners of any county may locate, construct, widen, straighten, or extend bridges and viaducts over streams and other topographical impediments to public traffic within the county. This applies equally to culverts, necessary approaches, abutments, embankments, fills, and piers. No county may enter any property or act in derogation of the lawful authority of any political subdivision without its consent. In addition, this act does not apply to any matters covered by provisions of the State Highway Law. Whenever it becomes necessary to widen, alter, or straighten the course of any unnavigable stream, the county may enter upon adajacent land and take, injure, and destroy any land necessary to change the course of such stream. Any county may maintain dykes, banks, and causeways across any unnavigable stream for the purpose of protecting county bridges and public highways from tide floods. In connection with this authority, the county may take, injure, and destroy any necessary property. Changes in an existing stream channel requires the approval of the Department of Forests and Waters. If a required embankment or causeway requires more expense than the adjoining townships can bear, it may be entered on the record as a county improvement. (Schram-Florida)
W70-02934

PREVENTION AND CONTROL OF FLOODS.

Pa Stat Ann tit 16, sec 1947 (1956).

Descriptors: *Pennsylvania, *Flood control, *Flood proofing, *Local governments, Legislation, Reservoirs, Flood protection, Floods, Streams, Rivers, Storm drains, Drainage systems, Detention reservoirs, Financing, Government finance, Administrative agencies, Maintenance, River regulation, Control systems.

For the prevention and control of floods, the board of county commissioners may: (1) borrow, appropriate, and expend money; (2) acquire real property by purchase or dedication; (3) regulate and control rivers, streams, and storm water drainage systems; and (4) make contracts and expenditures for the cleansing, regulation, and improvement of streams, drainage systems, and storage or retaining reservoirs. The commissioners may also make expenditures for investigating and examining the condition of rivers, drainage systems, and reservoirs. The commissioners may enter into arrangements with other public authorities, either federal or state, to further these purposes. In exercising these powers, the county commissioners may issue interest bearing bonds in accordance with the Municipal Borrowing Law. (Schram-Florida)
W70-02939

AUTHORITY TO CONTRACT WITH THE UNITED STATES IN FLOOD CONTROL AND DRAINAGE PROJECTS.
Miss Code Ann sec 8038.3 (1956).

Descriptors: *Mississippi, *Federal government, *Flood control, *Drainage programs, Legislation, Navigation, Navigable waters, Highways, Highway relocation, Drainage, Floods, Federal project policy, Property values, Cost allocation, Water resources development, Navigable rivers, Construction, Construction costs, Contracts.

The State Highway Commission may enter into agreements with the Federal government or any agency thereof for the alteration, relocation, reconstruction, or abandonment of state highways, and the conveyance of all state interest in such property where the property is necessary for the construction of flood control, navigation, or drainage projects approved by the Federal government. These agreements and conveyances shall be made upon payment of a consideration deemed reasonable both by the State Highway Commission and by the agency of Federal government affected. No expenses arising from the creation and maintenance of detours will be paid by the Federal government. (Casey-Florida)
W70-02942

BRIDGE AND PARK COMMISSIONS.
Miss Code Ann secs 5974-01, 5974-02, 5974-04 (Supp 1968).

Descriptors: *Mississippi, *Navigation, *Construction, *Harbors, Legislation, Legal aspects, Navigable waters, Cities, Gulf of Mexico, Administrative agencies, Bridge construction, Parks, Contracts, Eminent domain, Dredging, Channel improvement, Reclamation, Maintenance, Piers, Marinas, Jetties, Leases, Fishing, Financing, Surveys, Investigations, Tunnel construction, Boating, Beds, Sewerage, Recreation facilities, Islands, Federal government, Local governments.
Identifiers: *Harbor facilities, Water systems, Ferries.

The purpose of this act is to encourage and assist the economic and commercial development of navigation, harbor, boating, and related facilities in or near the navigable waters of the state. Cities and counties which meet specified standards have the authority to create bridge and park commissions. these commissions have the general power to sue, contract, and exercise eminent domain. In addition, commissioners are specifically granted power to: (1) acquire island located within specified proximity to the city or county for park, recreational, harbor development, and similar purposes; (2) purchase from the state any submerged lands adjacent to such islands for use as filling, provided no obstruction to navigation will be created thereby; (3) construct, build, maintain, and operate bridges, ferries, causeways, or tunnels to connect islands with the mainland; (4) acquire or construct any type of permanent improvements necessary to make commission property usable as public parks, parkways, boulevards, or as otherwise provided; (5) dredge, deepen and widen any channel in aid of navigation and harbor development; and (6) cooperate, consult, and contract with the federal government in furtherance of the foregoing powers. (Kieth-Florida)
W70-02944

PLANS FOR MULTIPLE USE OF THE WATER RESOURCES IN THE LENA RIVER,
For primary bibliographic entry see Field 06B.
W70-02949

THE EFFICIENCY OF HORIZONTAL DRAINAGE LAYERS FOR ACCELERATING CONSOLIDATION OF CLAY EMBANKMENTS,
King's Coll., London (England).
For primary bibliographic entry see Field 08D.
W70-02953

FROMME V UNITED STATES (COMPENSATION FOR THE TAKING OF A FLOWAGE EASEMENT).

412 F2d 1192-1197 (Ct Cl 1969).

Descriptors: *Texas, *Eminent domain, *Easements, *Flooding, Inland waterways, Condemnation, Flood plains, Levees, Rivers, Tributaries, Water levels, Elevation, Channels, Rainfall, Overflow, Spoil banks, Basins, Bays, Runoff, Drainage, Construction, Land use, Legal aspects, Judicial decisions, United States, Floodwater, Compensation.
Identifiers: *Corps of Engineers, Flowage easements.

Plaintiff sued the United States for compensation for the taking of a flowage easement over plaintiff's land. The Corps of Engineers constructed a channel for the Gulf Intracoastal Waterway. A temporary levee and spoil bank were also constructed, as well as a permanent levee. The permanent levee impeded the runoff of floodwaters of the Guadalupe River from claimant's land. The court of claims dismissed plaintiff's petition, holding that there was no taking of a permanent interest in the land. The interference with runoff due to temporary construction ceased to exist upon completion of the channel. Interference due to permanent construction was not so great as to meet the court-established test for creation of a flowage easement. This test was formulated in United States v Cress, 243 US 316 (1917), and requires intermittent, frequent, and inevitably recurring flooding of the land. (Duss-Florida)
W70-02961

ECONOMICS OF LEAK SURVEYS,
Pitometer Associates, Pittsburgh, Pa.
For primary bibliographic entry see Field 06C.
W70-03006

THE FLOOD CONTROL CONTROVERSY, BIG-DAMS, LITTLE DAMS, AND LAND MANAGEMENT,
Luna B. Leopold, and Thomas Maddock, Jr.

New York, The Ronald Press Co, 1954. 278 p.

Descriptors: *Flood control, *Dams, *Land management, Water resources, Costs, Benefits, Administration, Zoning, Water systems, Engineering, Levees, Floodways, Channel improvement, Reservoirs, Planning, Flood protection, Cost-benefit ratio.
Identifiers: River flood plain, Flood insurance, Downstream programs, Upstream programs, Federal interest, Local participation.

The purpose of this book is to investigate the facts regarding flood control, a subject that has given rise to extreme controversy in the United States in recent years. Sections of this study deal with: the flood control problem, administrative elements of a flood control program, engineering measures for flood control, land management, downstream and upstream programs for flood control, the federal interest, and local participation. The book considers questions which recur in many resource fields: the definition of the public interest, the allocation of the costs and benefits of resource development, and the economic and political means for carrying this development forward. The controversy over flood control in the United States illustrates the conflicts of interest and opinion that seem bound to arise over matters of resource development and use in any country. Most of these conflicts are complicated. In the present account one can grasp how difficult it is to achieve balanced resource programs and to apportion their cost equitably. It is inevitable that similar controversies should arise in many fields as the use of land and water resources becomes more intensive and competitive and as the economies of the less developed countries are primed toward greater productivity and integration. (Loeb-Rutgers)
W70-03013

RIVER MANAGEMENT.
For primary bibliographic entry see Field 06D.
W70-03015

WEBBERS FALLS LOCK AND DAM, ARKANSAS RIVER NAVIGATION PROJECT; HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
For primary bibliographic entry see Field 08B.
W70-03028

GALVESTON BAY HURRICANE SURGE STUDY; REPORT 1, EFFECTS OF PROPOSED BARRIERS ON HURRICANE SURGE HEIGHTS; HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
For primary bibliographic entry see Field 08B.
W70-03029

LOW-WATER WEIRS ON BOEUF AND TENSAS RIVERS, BAYOU MACON, AND BIG AND COLEWA CREEKS, ARKANSAS AND LOUISIANA; HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
For primary bibliographic entry see Field 08B.
W70-03030

OUTLET WORKS FOR NEW HOPE RESERVOIR, CAPE FEAR RIVER BASIN, NORTH CAROLINA, HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
For primary bibliographic entry see Field 08B.
W70-03031

SPILLWAY FOR HUGO DAM, KIAMICHI RIVER, OKLAHOMA; HYDRAULIC INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
For primary bibliographic entry see Field 08B.
W70-03032

CHANNEL IMPROVEMENT, FIRE ISLAND INLET, NEW YORK; HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
For primary bibliographic entry see Field 08B.
W70-03033

FLOOD PLAIN INFORMATION, KERN RIVER, BAKERSFIELD, CALIFORNIA.
Corps of Engineers, Sacramento, Calif.

Corps of Engineers Flood Plain Report, Oct 1969. 39 p, 25 fig, 10 plate, 8 tab.

Descriptors: *Floods, *Flood damage, *Flood plains, Flood control, Non-structural alternatives, California, Maximum probable flood, Historic flood.
Identifiers: Kern River, Bakersfield (Calif), Standard project flood, Intermediate regional flood.

Flooding of the Kern River, Bakersfield, California is described based on records of rainfall, runoff, and historical and present flood heights. Included are photographs, profiles, and cross sections that indicate the extent of past flooding and flooding which may be expected in the future. Bakersfield and Oildale are cities affected. The information is useful for surveys by water resources managers and others in planning ways to minimize vulnerability to flood damages by better control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Lang-USGS)
W70-03090

HURRICANE CAMILLE TIDAL FLOODS OF AUGUST 1969 ALONG THE GULF COAST, OCEAN SPRINGS-DEER ISLAND QUADRANGLES, MISSISSIPPI,
Geological Survey, Washington, D.C.
K. V. Wilson, and James W. Hudson.
Available from the US Geological Survey, Wash, DC, 20240, for $0.75 per copy. Geol Surv Hydrol Invest Atlas HA-405, 1 sheet, 1969. Test, 2 fig, 1 map, 1 photo, 1 tab, 3 ref.

Descriptors: *Floods, *Mississippi, *Hurricanes, *Flood damage, *Coasts, Tidal effects, Atmospheric pressure, Rain, Surges, Wind velocity, Winds, Disasters, Storms, Waves (Water), Water levels, Water level fluctuations, Inlets (Waterways), Sea level, Shores.
Identifiers: *Hurricane Camille (1969), Ocean Springs (Miss), Deer Island (Miss), Tidal floods, Storm tides.

The areas flooded by hurricane Camille tides of August 18, 1969 along the Mississippi Gulf Coast are shown in a series of hydrologic atlases. The Atlas of the Ocean Springs and Deer Island quadrangles show flooded areas on a topographic map scaled 1:24,000. Camille was the most intense hurricane on record to enter the U.S. mainland. Estimated maximum winds were 190 mph, and the central pressure was 26.61 inches of mercury. The eye of the storm, traveling about due north, passed over the Waveland-Bay St. Louis area and winds of over 75 mph extended about 50 mi on each side. Maximum precipitation was 10 inches. Flooding was most severe in the Pass Christian area where tides reached 25 ft above msl. High tide frequency and annual maximum tide are shown by graphs. (Knapp-USGS)
W70-03097

FLOODS OF APRIL 28, 1966, IN THE NORTHERN PART OF DALLAS, TEXAS,
Geological Survey, Washington, D.C.
Willard B. Mills, and Elmer E. Schroeder.
Geol Survey Water-Supply Paper 1870-B, p B1-B37, 1969. 37 p, 18 fig, 2 plate, 1 tab, 8 ref.

Descriptors: *Floods, *Texas, *Storms, Rainfall, Rainfall intensity, Runoff, Rainfall-runoff relationships, Data collections, Hydrologic data, Streamflow, Stage-discharge relations, Hydrographs, Profiles, Flood damage.
Identifiers: Dallas (Texas).

The floods of April 28, 1966, in the northern part of Dallas, Tex., caused heavy damage to a relatively small area. Flood damage was estimated at $2,500,000; and of this amount, $1,330,000 damage was along Bachman Branch, which has a drainage area of 12.3 square miles. At least 7 persons died as a direct result of the floodwaters. The flood was caused by a 5-hour storm in the early hours of April 28. Antecedent rainfall had so saturated the area that the intense, but relatively low, total rainfall (less than a 50-year return period) caused historical floods to be exceeded at many points. A peak runoff rate of 3,160 cfs per sq mi occurred on a 1.5 sq-mi area within the watershed. (Knapp-USGS)
W70-03098

FLOODS OF JUNE 1965 IN SOUTH PLATTE RIVER BASIN, COLORADO,
Geological Survey, Washington, D.C.
H. F. Matthai.
Geol Surv Water-Supply Paper 1850-B, p B1-B64, 1969. 64 p, 12 fig, 4 plate, 4 tab, 15 ref.

Descriptors: *Floods, *Colorado, *Rainfall-runoff relationships, Streamflow, Stage-discharge relations, Flood plains, Discharge (Water), Hydrologic data, Data collections, Duration curves, Hydrographs, Profiles, Flood damage, Disasters.
Identifiers: South Platte River, Denver (Colo).

Heavy, intense rains in three areas, on June 14-17, 1965 caused outstanding floods on many streams in the South Platte River basin from Plum Creek, just south of Denver, downstream to the Colorado-Nebraska State line. The flood-producing storms followed a relatively wet period, and rainfall of as much as 14 inches in a few hours was reported. Previous record high discharges on many tributaries with drainage areas on the plains were exceeded, sometimes severalfold. The attenuation of the peak flow by channel storage as the flood passed through Denver was considerable; yet the peak discharge of 40,300 cfs of the South Platte River at Denver was 1.8 times the previously recorded high of 22,000 cfs in a period of record starting in 1889. The 1965 peak would have been still higher except that all flow from Cherry Creek was stored inCherry Creek Reservoir. Descriptions of the storms and floods, detailed streamflow records, and information on damages, flood profiles, inundated areas, and flood frequency are included in this report. Several comparisons of the magnitude of the flood are made, and all indicate that an outstanding hydrologic event occurred. (Knapp-USGS)
W70-03100

THE EFFICIENCY OF DOUBLE-SIDED CONTROL DRAINAGE SYSTEMS IN THE UKRAINE (RUSSIAN),
G. G. Afanas'yev.
Gidrotekhnika i Melioratsiya, No 8, p 59-65, Aug 1969. 7 tab, 3 ref.

Descriptors: *Drainage systems, *Efficiencies, *Reclamation, Canals, Soils, Climates, Cost analysis, Economic justification, Dry seasons, Topography, Hydrogeology, Crops, Productivity.
Identifiers: *USSR, Ukraine.

The effect of double-sided control drainage on the productivity and cost of land reclamation was ex-

perimentally investigated. The cost of reclamation in the Kiev region is 150 rubles and 83 rubles per acre using double-sided and one-sided drainage systems, respectively; however the productivity of land under the double-sided drainage control is over 2 times greater than that under the one-sided drainage control. (Gabriel-USGS)
W70-03119

FLOOD-PLAIN DRAINAGE AND FLOOD DISCHARGES OF THE UKRAINIAN SMALL RIVERS (RUSSIAN),
Ukrainian Scientific Research Inst. of Hydroengineering and Land Reclamation (USSR).
For primary bibliographic entry see Field 02E.
W70-03120

COMBINED UNDERFLOW STORAGE PLAN FOR POLLUTION AND FLOOD CONTROL IN THE CHICAGO METROPOLITAN AREA,
Chicago Bureau of Engineering, Ill.
For primary bibliographic entry see Field 05G.
W70-03142

AQUEDUCT CONTROL SYSTEM SAVES $100 MILLION,
California State Dept. of Water Resources, Sacramento.
For primary bibliographic entry see Field 08A.
W70-03146

LOS ANGELES CITY PROPER AND HARBOR MASTER PLAN FOR WATER SUPPLY,
Los Angeles City Dept. of Water and Power, Calif. Water Engineering Design Div.
For primary bibliographic entry see Field 06D.
W70-03147

URBAN STORM DRAINAGE CRITERIA MANUAL.
Wright-McLaughlin Engineers, Denver, Colo.

Work performed for the Denver Regional Council of Federal Governments, Denver, Colorado. Wright-McLaughlin Engineers, Vols I and II, Mar 1969. 726 p, 39 tab, 139 fig, 171 ref. HUD Project Colo P-62.

Descriptors: *Drainage engineering, *Design criteria, *Drainage programs, *Drainage practices, *Storm runoff, *Surface drainage, *Storm drains, *Flood control, Rainfall-runoff relationships, Hydrology, Hydraulic structures, Water law, Administration, Watershed management, Flood proofing, Hydraulics, Intakes, Open channels, Storage, Culverts.
Identifiers: *Denver, *Denver Regional Council of Governments, *Storm drainage policy, Major drainage system, Streets for drainage channels, Curb and gutter design.

The manual was written to suggest techniques, methodology and guidelines to facilitate the implementation of a new and more thorough approach to storm drainage problems in Metropolitan Denver. This work appears to be the most comprehensive treatment of urban storm drainage design criteria available. The authors recommend adoption of the manual by government agencies in Metropolitan Denver, and that the Denver Regional Council of Governments provide coordinate drainage activities. Volume 1 includes chapters on suggested drainage policy, Colorado drainage law, drainage planning for initial and major drainage, rainfall data and analyses, rainfall-runoff relationships, storm sewer design criteria and standards, and drainage criteria for the design of streets and storm water inlets. Volume 2 deals with criteria for the design of the 'major' drainage system; i.e., the system which carries the runoff from a storm having a frequency of occurence of once in 100 years. Included are design criteria for open channels, large diameter conduits, box culverts and inlets, energy dissipators, baffle and accelerator chutes, and channel drops. The benefits of temporary storage in reducing peak runoff rates is discussed. Flood proofing techniques, the use of irrigation ditches and benefits of well designed drainage systems are discussed. (See also W70-03149 thru W70-03152). (Poertner-Chicago)
W70-03148

DRAINAGE POLICY, (Chapter 1).
Wright-McLaughlin Engineers, Denver, Colo.

In: Urban Storm Drainage Criteria Manual, Vol 1, Wright-McLaughlin Engineers, Denver, Mar 1969. 54 p. HUD Project Colo P-62.

Descriptors: *Design criteria, *Water policy, *Drainage programs, *Drainage practices, *Drainage engineering, *Storm runoff, *Watershed management, *Flood control, Flood proofing, Design standards, Flood plains, Design storm, Storage, Watershed basins, Surface runoff, Drainage, Surface drainage, Drainage systems, Drainage water, Hydrology, Ponding, Rational formula, Flood plain insurance.
Identifiers: *Denver, *Denver Regional Council of Governments, *Storm drainage policy.

The manual was written to suggest techniques, methodology, and guidelines needed to facilitate the implementation of a new and more thorough approach to storm drainage problems in Metropolitan Denver. The chapter on 'Policy' recommends the adoption of this manual by government agencies. Storm drainage is presented as a 'space-allocation' problem demanding planning and integration on a regional basis. A set of policy statements, based upon underlying principles, technical criteria, and data is recommended to provide direction for planning, providing, and operating drainage facilities. These statements call for the initiation of flood plain management programs and a program for collecting and analyzing stormwater runoff and flood data. Stormwater drainage master plans, based upon the criteria in this manual and consistent with the comprehensive plan, are encouraged for adoption by each urbanized drainage basin. Coordination by the Denver Regional Council of Governments is suggested. The report includes recommendations for participation by governmental units in the National Flood Insurance Act of 1968. Design criteria discussed relate to storm frequency, initial and major drainage system considerations, natural drainageways, water quality control, and runoff computation. Emphasis is placed upon coordinating drainage planning with transportation and open space planning. (See W70-03148). (Poertner-Chicago)
W70-03149

SUMMARY OF COLORADO DRAINAGE, (Chapter 2), AND PLANNING, (Chapter 3).
Wright-McLaughlin Engineers, Denver, Colo.

In: Urban Storm Drainage Criteria Manual, Vol 1, Wright-McLaughlin Engineers, Denver, Mar 1969. 43 p, 6 ref. HUD Project Colo P-62.

Descriptors: *Water law, *Legal aspects, *Legislation, *Natural flow doctrine, *Administration, *Watershed management, *Flood routing, *Water resources planning, *Riparian rights, Water rights, Judicial decisions, Obstructions to flow, Drainage programs, Flood control.
Identifiers: *Denver, *Denver Regional Council of Governments, *Liability for flood damages.

The manual was written to suggest techniques, methodology, and guidelines to facilitate the implementation of a new and more thorough approach to storm drainage problems in Metropolitan Denver. The chapter on 'Law' presents the responsibilities and legal liabilities of municipalities relating to planning, constructing, operating, maintaining and repairing drainage improvements. The importance of obtaining all pertinent facts and developing a plan before initiating a proposed improvement is stressed. Municipalities proceeding in this manner can be relatively assured of no legal complications and should be able to use any of several different means to finance proposed improvements. Specific legal actions are cited and briefed. The chapter on 'Planning' cites drainage systems as being subsystems of the total urban system, affecting orderly growth and development. Planning should include consideration of multiple-uses and additional benefits which can result from well planned drainage systems. Emphasis is placed upon adopting plans which incorporate undisturbed natural swales and waterways. Other aspects discussed include drainage management measures, master planning, flood plain planning, initial and major systems, transportation facilities relationships, open space, and planning and sizing of storm sewer systems. (See W70-03148). (Poertner-Chicago)
W70-03150

RAINFALL FOR THE DENVER REGION, (Chapter 4), AND RUNOFF, (Chapter 5).
Wright-McLaughlin Engineers, Denver, Colo.

In: Urban Storm Drainage Criteria Manual, Vol 1, Wright-McLaughlin Engineers, Denver, Mar 1969. 77 p, 13 tab, 19 fig, 38 ref. HUD Project Colo P-62.

Descriptors: *Rainfall, *Runoff, *Rainfall disposition, *Rainfall intensity, *Hydrology, *Rainfall-runoff relationships, *Storm runoff, *Design criteria, *Drainage engineering, Design storm, Duration curves, Hydrograph analysis, Unit hydrograph, Rational formula, Flood forecasting, Frequency analysis.
Identifiers: *Denver, *Denver Regional Council of Governments.

The manual was written to suggest techniques, methodology and guidelines to facilitate the implementation of a new and more thorough approach to storm drainage problems in Metropolitan Denver. The chapter on 'Rainfall' suggests a rainfall analysis technique similar to that employed by the U.S. Weather Bureau (Technical Papers Nos. 28, 29 and 40). The chapter includes several key rainfall-frequency maps making it possible to determine any combination of return-period from one to 100 years and durations from 5 minutes to 24 hours. Nine isohyetal maps, labeled 'Rainfall depth-Duration-Frequency Map, Denver Region,' are presented. The chapter on 'Runoff' describes in detail the following three methods of calculating runoff applicable to Metropolitan Denver: (1) Rational Method, for sewers draining areas less than 200 acres; (2) Colorado Unit Hydrograph Procedure, for sewers draining basins in excess of 200 acres; and (3) Statistical Analysis, for streams upon which future urbanization will have little effect on runoff inflow. Two statistical methods are illustrated: (1) Log-Pearson Type III, and (2) Index Flood. Flood Plain Information Reports, prepared by the Corps of Engineers for delimiting flood hazard areas and stream surface profiles, are cited. Users are urged to allow for anticipated urbanization. (See W70-03148). (Poertner-Chicago)
W70-03151

STORM SEWERS (Chapter 6); STREETS AND INTERSECTIONS (Chapter 7); AND STORM WATER INLETS (Chapter 8).
Wright-McLaughlin Engineers, Denver, Colo.

In: Urban Storm Drainage Criteria Manual, Vol 1, Wright-McLaughlin Engineers, Denver, Mar 1969. 252 p, 18 tab, 60 fig, 36 ref. HUD Project Colo P-62.

Descriptors: *Storm drains, *Drainage systems, *Design criteria, *Hydraulic design, *Intakes, Design standards, Surface drainage.
Identifiers: *Street drainage, *Street design criteria, *Stormwater inlets, Curb and gutter design, Streets for drainage channels.

The manual was written to suggest techniques, methodology and guidelines to facilitate the imple-

mentation of a new and more thorough approach to storm drainage problems in Metropolitan Denver. The chapter on 'Storm Sewers' presents criteria intended for use by engineers in designing systems of storm sewers for collecting and conveying stormwater runoff to points of discharge in the major drainage system. Design procedures and criteria are recommended for all elements of a typical storm sewer system, including conduits, channels, inlets, bends, junctions, manholes, outlets, pressure systems, and the related hydrologic aspects of rainfall and runoff. The chapter on 'Streets' presents criteria and suggested procedures and standards for street design. Drainage design of streets is approached from the standpoint of providing systems to drain streets and, secondarily, using streets as integral parts of local drainage systems. The chapter on 'Storm Inlets' discusses the various types of inlets devices used for providing openings to drain stormwater from streets into sewers. Design criteria and inlet capacity graphs are treated in detail. Several examples of typical designs of storm sewers, streets, and stormwater inlets are presented. (See W70-03148). (Poertner-Chicago)
W70-03152

IMPORTANCE OF MATHEMATICAL METHOD AND COMPUTING TECHNIQUE APPLICATION TO WATER RESOURCE PLANNING AND CONTROL,
All-Union Research Inst. for Water Engineering and Reclamation, Moscow (USSR).
For primary bibliographic entry see Field 06A.
W70-03166

NEW METHODS FOR USING STOCHASTIC PROCEDURES IN WATER RESOURCE PLANNING,
Computer Technology, Inc., Arlington, Tex.
For primary bibliographic entry see Field 06A.
W70-03171

WATER TRANSPORT COSTS,
Binnie and Partners, London (England); and King's Coll., London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 06D.
W70-03172

MATHEMATICAL MODELS FOR OPTIMIZING THE ALLOCATION OF STORED WATER,
Nevada Univ., Reno. Center for Water Resources Research.
For primary bibliographic entry see Field 06A.
W70-03173

STORAGE YIELD: EXTENDING THE SEQUENT PEAK ALGORITHM TO MULTIPLE RESERVOIRS,
Water Resources Engineers, Inc., Springfield, Va.; and Texas Water Development Board, Austin.
For primary bibliographic entry see Field 06D.
W70-03175

DIVERSION OF WATERS INTO OTHER STATES.

N J Stat Ann 58:3-1 (1966).

Descriptors: *New Jersey, *Diversion, *Interstate, *Conduits, Legal aspects, Regulation, Legislation, Pipes, Ditches, Canals, Bodies of water, Transportation, Administrative agencies, Fresh water.

No waters of any well, fresh-water lake, pond, brook, creek, river or stream, nor any subsurface or percolating waters shall be transported or carried through pipes, conduits, ditches or canals into any other state for use therein, except where the consent in writing of the Water Policy and Supply Council of the Division of Water Policy and Supply of the Department of Conservation and Economic Development has been obtained. A petition in writing for such consent must be filed with the Division accompanied by such plans and documents as the Division may require. The Division shall enforce the provisions of this section, and the Superior Court by injunction may, upon application of the Division, prevent any unauthorized diversion or transportation. (Sisserson-Florida)
W70-03179

BLACKBURN V GAYDOU (FLOOD DAMAGES FROM OBSTRUCTING THE FLOW).
245 SW2d 161-171 (Mo Ct App 1951).

Descriptors: *Missouri, *Dikes, *Flood damage, *Obstruction to flow, Barriers, Diversion, Streamflow, Natural Flow Doctrine, Relative rights, Judicial decisions, Overflow, Streams, Flow, Natural flow, Surface drainage, Surface runoff, Surface waters, Drainage, Drainage water, Damages, Earthworks, Diversion structures, Weather patterns, Natural use, Repulsion (Legal aspects), Overflow.

Plaintiff alleged that defendant negligently constructed a dike in a creek flowing along the north side of both plaintiff's and defendant's land thereby obstructing the creek's natural flow, which caused an overflow onto plaintiff's land. Plaintiff asked for temporary and permanent damages. The court held that while a cause of action was stated, plaintiff was not entitled to damages for a permanent injury. Surface water is a common enemy which may be warded onto the land of an adjacent or lower owner. However, it may not be unneccessarily collected and discharged to the lower owner's damage. The upper owner may not discharge water in a different manner than it would usually have gone in the natural course of drainage, nor may a natural stream be dammed and the waters diverted to the damage of property without compensation therefor. However, the injury here did not occur until three years after construction of the dike, and a continued injury would depend upon weather conditions. (Smith-Florida)
W70-03181

SWAMP LAND GRANTS AND THE CONSERVATION FUND.
Wis Stat Ann secs 25.235, 25.29 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Financing, *Reforestation, *Conservation, Legislation, Legal aspects, Swamps, Overflow, United States, Arkansas, Permits, Administrative agencies, Fishing, Leases, Marshes, Schools (Education), Economics, Expenditures, Government finance, Income, Taxes, Land development, Land management.

The Congress of the United States passed an act to enable the state of Arkansas and other states to reclaim the swamp lands within their limits in 1850. All swamp and overflowed lands received by virtue of said act are declared trust lands. All income derived from trust lands will be applied exclusively to the school fund. All moneys accruing to the state for or in behalf of the State Conservation Commission, except fines and moneys payable to the Reforestation Fund, will constitute the Conservation Fund. No money will be expended from the Conservation Fund except in pursuance of an appropriation by law. Funds accruing to the Conservation Fund from the issuance of hunting and fishing permits will not be diverted for any purposes other than those delineated by the Conservation Commission. A set portion of each permit fee will be used toward acquisition and leasing of public hunting and fishing grounds. Specified moneys received into the Conservation Fund must be expended for forest development and reforestation. (Keith-Florida)
W70-03183

PREVENTION AND CONTROL OF FLOODS.
Pa Stat Ann tit 16, sec 5147 (1956).

Descriptors: *Pennsylvania, *Flood control, *Channel improvement, *Local governments, Control, Water control, Abatement, Drainage systems, Flood protection, Floodways, Multiple-purpose projects, Flood routing, Rivers, Streams, Storm drains, Drains, Storm runoff, River basin development, Flow control, Flood forecasting, Flooding, Costs, Economics, Cost sharing, Budgeting.

For the purpose of cleansing, regulating, improving and controlling rivers, streams, and storm drainage systems for the prevention and control of floods, the board of county commissioners may borrow, appropriate and expend money and may acquire real property or any interest therein. The commission may make expenditures to investigate and examine such waters and may seek contribution from the United States or any other state. (Smith-Florida)
W70-03187

FLOOD CONTROL PROJECTS.
Pa Stat Ann tit 32, secs 666-672 (1967), as amended, (Supp 1969).

Descriptors: *Pennsylvania, *Flood control, *Highways, *Reservoirs, Abatement, Check structures, Drainage systems, Flood damage, Flood protection, Flood routing, Control structures, Diversion structures, Flooding, Cities, Local governments, State governments, Federal government, Water resources development, Interstate, Riparian rights, Financing, Easements.

Municipalities and the Department of Highways may agree with the Water and Power Resources Board or federal agencies to relocate roads, streets, bridges, or viaducts to aid any state or federal flood control works. Any state highway becoming flooded, unnecessary, or dangerous because of a flood control reservoir may, with the Governor's approval, be closed by the Secretary of Highways. The Secretary and municipalities may grant easements or flowage rights to the United States to submerge highways, streets, roads and bridges during emergency floods. The Board may accept and operate completed federal flood control works. The rights to waters in a flood control district are limited to those rights in existence before such district was created. Any increase in possible use of these waters is owned by the state. Special financing is provided for, and a flood control fund is created. The Water and Power Resources Board is empowered to cooperate with other states in flood control projects and may delegate certain powers to the federal government. (Smith-Florida)
W70-03192

NAVIGABLE WATERS AND NAVIGATION IN GENERAL.
Wis Stat Ann secs 30.10, 30.11 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Navigable waters, *Navigation, *Bulkhead line, Legislation, Legal aspects, Lakes, Streams, Bayous, Harbors, Basins, Canals, Dams, Bridges, Cities, Regulation, Boundaries (Property), Leases, Beds, Riparian rights, Administrative agencies, Resource development, Bridge construction, Construction, Standards.
Identifiers: *Public waters, *Obstructions to navigation, *Riparian owners.

All lakes within the state which are navigable in fact are declared to be navigable and public waters. All steams, sloughs, bayous, and marsh outlets which are navigable in fact are declared navigable to the extent that no dam, bridge, or other obstruction shall be constructed in or over them without the permission of the state. All inner harbors, turning basins, waterways, slips, and canals created by any city for purposes of public navigation and all outer harbors connecting interior navigation with lake navigation are declared navigable waters. The power of cities to construct bridges over streams is not impaired. Boundaries of riparian land and

rights of riparian owners will be determined in conformity with the common law, with specified exceptions. Cities may, subject to the approval of the Department of Resource Development, establish a bulkhead line and change it from time to time. The standards and methods for establishing bulkhead lines are specified. Establishment of a bulkhead line will not abridge the riparian rights of riparian owners. The requisites for leasing by the Department of Public Lands for specified purposes are set forth. (Keith-Florida)
W70-03195

DIVERSION AND ALTERATION OF WATERCOURSES.

Wis Stat Ann secs 30.18, 30.19, 30.195 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Diversion, *Artificial watercourses, *Water resources development, Legislation, Legal aspects, Streams, Lakes, Water levels, Riparian land, Riparian rights, Public rights, Surplus water, Permits, Structures, Maps, Surveys, Planning, Channels, Canals, Condemnation, High water mark, Banks, Navigation, Highways, Wildlife conservation, Administrative agencies.
Identifiers: Penalties (Criminal).

The surplus water of any stream may be temporarily diverted in order to restore or maintain the normal water level of any navigable lake or stream. Water, other than surplus water, may be diverted with the consent of riparian owners to be damaged thereby if such diversion is for agricultural purposes and will not be detrimental to public rights. Surplus water means any water of a stream which is not being beneficially used. Before any water may be diverted, a permit must be obtained from the Department of Resource Development. The method for applying for such permits and the conditions on which such permits are granted are set forth. It is unlawful to begin any work designed to connect any watercourse or body of water with any existing navigable watercourse or body of water without first obtaining a permit from the Department of Resource Development. The method of application, requirement for public hearing and conditons under which such permits may be granted are set forth. Criminal penalties are provided for violation of any of the foregoing provisions. It is unlawful to change the course of a navigable stream without first having obtained a permit therefor from the Department pursuant to statute. (Keith-Florida)
W70-03197

CONSTRUCTION AND MAINTENANCE OF DAMS.

Wis Stat Ann secs 31.04-31.09 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Administrative agencies, *Dams, *Water control, Cities, Navigable waters, Permits, Damsites, Eminent domain, Construction, Piers, Hydraulics, Recreation, Benefits, Economic justification, Conservation, Public rights, Lakes, Lake shores, Aesthetics, Rivers, Water levels, Height, Property values, Legislation, Electric power production, Operation and maintenance.

Permits to construct, operate, and maintain dams may be granted to persons, corporations, or municipalities pursuant to this law. Written applications for permits contain a general description of the proposed dam, the proposed site, the intended purpose of the dam, and an estimate of the dam's capabilities of producing hydraulic power. The Department of Resource Development shall hold public hearings on applications for permits. The Department shall consider public interest, economic effects, and recreational values when reviewing each application. Scenic beauty has a high priority in this consideration. The Department shall also investigate the potentialities of any lakes and lake shores which would be created by the flowage of proposed dams. The Department shall also weigh the effects of dams upon rivers. If the economic need for electric power is less than the value of recreation and scenic beauty, the Department must deny the permit. Provision is also made for applications for permits to operate existing dams. Procedures for approving such applications are substantially the same as those governing the construction of new dams. (Duss-Florida)
W70-03200

MAINTENANCE OF DAMS AND DIKES FOR DRAINAGE CONTROL AND CONSERVATION.
Wis Stat Ann secs 31.36-31.38 (1967), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Administrative agencies, *Water conservation, *Drainage, Water control, Ditches, Flow, Rivers, Streams, Lakes, Dams, Dikes, Levees, Breakwaters, Shores, Banks, Right-of-way, Condemnation, Cost sharing, Conservation, Wildlife conservation, Furbearers, Aquatic animals, Birds, Breeding, Construction, Irrigation, Cost allocation, Decision making, Project planning, Cost analysis.
Identifiers: *Pisciculture.

The Water Regulatory Board is created to supervise the operation, repair, and maintenance of dams and dikes constructed across drainage ditches and streams within drainage districts, in the interest of drainage control, water conservation irrigation, and pisciculture. The Board is directed to provide areas suitable for the nesting and breeding of aquatic birds and the propagation of fur-bearing animals. The Board shall operate in cooperation with the various drainage districts throughout the state. Municipalities are directed to furnish the right-of-way for additional levees. Municipalities may authorize the acquisition, construction, maintenance, or repair of dams across any lakes or streams adjoining, or within, the limits of that municipality. After cost estimates of these projects are adopted by the municipality, project plans must be submitted to the Department of Resource Development or to the proper United States officer for approval. The method of cost assessment for improvements is set forth. (Duss-Florida)
W70-03201

CREATION OF TOWN SANITARY DISTRICTS FOR POLLUTION CONTROL AND WASTE DISPOSAL.
For primary bibliographic entry see Field 05G.
W70-03203

CONSTRUCTION, MAINTENANCE AND IMPROVEMENT OF DRAINS.

Wis Stat Ann secs 88.62-88.73 (Supp 1969).

Descriptors: *Wisconsin, *Drainage, *Drainage districts, *Maintenance, Maintenance costs, Construction costs, Administrative agencies, Drainage programs, Drainage systems, Budgeting, Cost sharing, Local governments, Water policy, Inspection, Contracts, Assessments, Drains, Legislation, Bridge construction.

A drainage board must maintain the drains of its drainage district and inspect them annually. When funds for maintenance of drains fall below five percent of the benefits of drainage, the boards shall levy assessments for the costs of maintenance and repair. Maintenance does not include the alteration or enlargement of drains. The boards may construct drains across railroad rights-of-way or utility installations. When the construction of a drain across a highway necessitates the reconstruction of a bridge the drainage district involved shall assume the costs of such reconstruction. The district must pay for damage to land outside the district caused by its activities. Where landowners of a district desire more thorough or different drainage and the drainage board determines that public health and welfare will be served, subdistricts may be formed to facilitate drainage. Dams found by the court to obstruct drainage may be removed. The owners of lands assessed for drainage expenses but inaccessible to existing drains may petition to have connecting drains constructed. (Dye-Florida)
W70-03204

DIVISION OF WATER.
Ohio Rev Code Ann secs 1521.01 thru 1521.13, 1521.41, 1521.42 (1964), as amended, (Supp 1970).

Descriptors: *Ohio, *Water resources, *Water resources development, *Water management (Applied), Legislation, Legal aspects, Wells, Surface waters, Subsurface waters, Aquifers, Water conservation, Water supply, Water utilization, Planning, Watersheds (Basins), Regulation, Water pollution, Investigations, Hydroelectric power, Flood control, Permits, Surveys, Hydrologic data, Ohio River, Utilities, Watercourses (Legal), Reservoirs, New York State Barge Canal, Dikes, Levees, Dams, Eminent domain, Administrative agencies.
Identifiers: *Salt Fork Lake.

'Water resources' means all surface waters occurring in channels and all subsurface waters occurring in aquifers which are available or may be made available to agricultural, industrial, commercial and domestic users. The Division of Water is created within the Department of Natural Resources. The Division of Water will: (1) collect, study and interpret all available data pertaining to the supply, use, conservation and replenishment of the underground and surface waters of the state; (2) be authorized to perform stream gauging within the state (3) advise the political subdivisions of the state regarding water conservation and ground water recharge; (4) regulate the drilling and operation of wells to prevent subsurface water contamination; (5) conduct a basic inventory of the water resources in each drainage basin within the state and develop a plan for the management of such resources; and (6) investigate flood control problems within the state. Entities engaged in well-digging must keep logs thereof and must furnish copies to the Division. No dam may be constructed without first obtaining a permit from the Division. The Division will control and maintain certain named reservoirs, dams, and canals. The Division will construct, control and manage the Salt Fork Lake project. (Keith-Florida)
W70-03211

OHIO WATER COMMISSION.
For primary bibliographic entry see Field 06B.
W70-03212

PUBLIC UTILITIES (RIGHT OF WAY DRAINAGE AND FENCES).

Ohio Rev Code Ann sec 4959.01 (Page 1953).

Descriptors: *Ohio, *Railroads, *Ditches, *Surface drainage, Drainage systems, Legislation, Drains, Drainage, Conduits, Drainage engineering, Outlets, Industrial water, Water, Flow, Water distribution, Water control, Swamps.

Except where the roadbed of a railroad contacts a swampland, the railroad must provide ditches or drains along the roadbed sufficient to conduct accumulating water to some proper outlet. (Powell-Florida)
W70-03215

PERFORMANCE OF TILE DRAINS UNDER IRRIGATION IN SOUTHERN ALBERTA,
Department of Agriculture, Lethbridge (Alberta); and Manitoba Univ., Winnipeg. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 03F.
W70-03227

4B. Groundwater Management

OBSERVATIONS ON WATER CONTENT CHANGES IN STRATIFIED SEDIMENTS DURING PIT RECHARGE,
Arizona Water Resources Research Center, Tucson.
L. G. Wilson.
Paper presented at 50th Annual Meeting of American Geophysical Union, Wash, DC, Apr 23, 1969. 40 p, 10 fig, 2 tab, 21 ref. OSW Grants No 14-01-0001-630 and 14-01-0001-1805.

Descriptors: *Pit recharge, *Sediments, *Flow characteristics, *Arizona, Flow, Alluvium, Basins, Water table, Piezometers, Hydraulic gradient, Drainage, Wells, Observation wells.
Identifiers: *Stratified sediments, Basin-fill stratigraphic units.

Two principal flow regimens were observed during Arizona pit recharge studies in stratified sediments overlying the 80-foot deep water table. The uppermost region was observed near the interface between the alluvium and basin-fill stratigraphic units. The lowermost region was apparent above the water table in materials of the basin-fill unit. Three main stages prevailed in the history of the two flow regimens: development stage, equilibrium stage, and drainage stage. Water content profiles, flow characteristics and piezometer data are discussed for these stages. It is concluded that cyclic recharging is a more effective management technique than continuous inundation in order to maximize recharge volumes. A regeneration of an open surface is apparently promoted by periodic drying periods thus sustaining favorable lateral hydraulic gradients. (Carstea-USGS)
W70-02887

THE LAW OF UNDERGROUND WATER; A HALF-CENTURY OF HUBER V MERKEL,
David L. Uelmen.
Wis L Rev, Vol 1953, No 3, p 491-515, May 1953. 25 p, 117 ref.

Descriptors: *Percolating water, *Underground streams, *Subsurface waters, *Confined water, Legislation, Judicial decisions, Reasonable use, Diversion, Wisconsin, New York, Hawaii, California, Water resources, Water policy, Water law, Prior appropriation, Water conservation, State governments, History, Natural gas, Oil, Exploitation, Administrative agencies.
Identifiers: *Common law.

Beginning with its origin in 1843, the author traces the development of the law of underground water. Non-statutory rules are discussed first. These fall into three groups: (1) the English Rule or common law rule; (2) the American Rule or reasonable use rule; and (3) the California Rule or the doctrine of correlative rights. In discussing these and later topics, the author utilizes judicial decisions to reveal the development of the law. Diversions of underground streams and diversions of percolating and artesian waters are treated in separate sections. The effect of malice in relation to underground water law is discussed. A summary of the non-statutory law is included. Various statutory materials are then discussed in relation to the problem of waste. The balance of the paper contains a development of Wisconsin's history in this area. The laws of New York and Hawaii are also discussed. The author concludes that the problem is to find the best method of regulating water for the benefit of the state without doing violence to the rights of private owners. Much of the law is said to be based on erroneous scientific and economic materials. Reference is made to a proposed statute designed to effectuate this policy. (Schram-Florida)
W70-02898

THE LAW OF UNDERGROUND WATER; A HALF-CENTURY OF HUBER V MERKEL (STATUTORY MATERIALS),
David L. Uelmen.
Wis L Rev, Vol 1953, No 3, p 503-515, May 1953.

Descriptors: *Wisconsin, *Subsurface waters, *Reasonable use, *Diversion, Legislation, Water policy, Water law, Oil, Natural gas, Administrative agencies, Regulation, History, Exploitation, Public rights, Confined water, Water conservation, Percolating water, Water resources, Economics, Well regulations.

Satutory materials relating to waste of underground waters are discussed. Statutes from several states declare that artesian wells must be capped to prevent waste when the water is not being used. One group of states has declared uncapped artesian wells to be a nuisance, with the owner being guilty of a misdemeanor. Wisconsin statutory law is discussed. In Wisconsin liability for waste depends upon whether the owner allowed the well to discharge more water than reasonably necessary and whether such action materially diminished the flow of another well in the vicinity. Various cases distinguishing natural gas and oil from water are discussed. After dealing with the laws in several other states, the author makes some general conclusions. He defines the problem as being the finding of the best method of regulating water without doing violence to the rights of private owners. Many of the extreme methods used today are based upon erroneous scientific and economic materials. The public interest is sufficient to justify legislation to prevent exploitation and waste by the owner of the land under which the water lies. (See W70-02898). (Schram-Florida)
W70-02900

GENERAL ECONOMIC ASPECTS OF UTILIZATION OF UNDERGROUND WATER FOR IRRIGATION IN HIGH PLAINS OF TEXAS,
For primary bibliographic entry see Field 03F.
W70-03010

THE ARTESIAN SYSTEM IN GEORGIA: STRATIGRAPHY AND HYDROLOGY OF THE OCALA,
Georgia University, Athens, Geology Dept.
Mark Rich, and Edward A. Stanley.
PB-189 041, Partial Completion Report, Georgia Water Resources Center, Nov 1969. 11 p, 6 tab, 20 ref. OWRR Project A-006-GA.

Descriptors: *Stratigraphy, *Paleohydrology, *Petrography, *Limestones, Porosity, Calcareous soils, Sedimentary petrology, Georgia.
Identifiers: *Ocala Limestone, *Little Stave Creek, Alabama, *Rich Hill Section (Georgia), *Coccoliths.

The report summarizes studies of rocks belonging to the Jackson Group in Southwestern Georgia (the Ocala Limestone). The stratigraphy of the Ocala is outlined. Field and laboratory work is documented including petrographic and stratigraphic analysis. Paleontological studies and analyses of the Ocala Limestone indicate that the necessary zonations and correlations could be made on the basis of calcareous nannoplankters. Biostratigraphic zonation of the Alabama Little Stave Creek section based on the distribution of 45 species of Coccolithophores showed three distinct units within the Eocene deposits. Use of nannoplankters in Georgia has been limited by widespread silification of the Ocala exposures. The report indicates that Coccoliths will prove to be useful for future subsurface studies in Georgia when it is known that silification of the Ocala Limestone has not taken place. (Conway-Georgia Tech)
W70-03037

SUBSURFACE IRRIGATION RESEARCH IN ARKANSAS,
Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 03F.
W70-03063

THE CONVOLUTION RELATION AS APPLIED TO ESTIMATING RECHARGE FROM AN EPHEMERAL STREAM,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 02F.
W70-03064

WATER AVAILABILITY IN URBAN AREAS OF THE SUSQUEHANNA RIVER BASIN - A PRELIMINARY APPRAISAL,
Geological Survey, Albany, N.Y.
Robert D. MacNish, Allan D. Randall, and Henry F. H. Ku.
New York Water Resources Commission Report of Investigation RI-7, 1969. 24 p, 15 fig, 6 ref.

Descriptors: *Water management (Applied), *Conjunctive use, *Streamflow, *Induced infiltration, *New York, Hydrographs, Hydrograph analysis, Statistical models, Statistical methods, Water storage, Aquifers, Water reuse, Artificial recharge, Low-flow augmentation.
Identifiers: *Susquehanna River basin, (N Y).

Using the mean of the logs of the monthly average flows, an average annual hydrograph was constructed for major streams in the three largest urban areas in the Susquehanna River basin in New York State. This logarithmic-based average hydrograph more nearly approximates daily flows than an arithmetic-base average hydrograph. Comparison of this hydrograph and the storage potential of local aquifers enables determination of the required volumes of upstream storage, or recycling of treated waste waters and artificial recharge necessary to sustain maximum induced infiltration and pumpage from groundwater storage. The desirability of using treated waste water in artificial recharge or streamflow augmentation is enhanced by the fact that recycling 60 percent of the treated waste water can double water availability for these urban areas. (Knapp-USGS)
W70-03102

ACCURACY OF WELL DISCHARGE COMPUTATIONS FROM CURVES OF THE DISCHARGE AS A FUNCTION OF THE DROP IN WATER LEVEL (TAKING THE DZHEZKAZGAN REGION AS AN EXAMPLE),
V. N. Ostrovskiy, and M. A. Khordikaynen.
Transl from Trudy Inst Gidrogeologii i Gidrofiziki, Akad Nauk Kazakhskoy SSR, Vol 1, p 198-201, 1968. Soviet Hydrology: Selected Papers, No 4, p 363-365, 1968. 3 p, 1 tab, 7 ref.

Descriptors: *Wells, *Groundwater movement, *Groundwater recharge, *Karst, Observation wells, Equations, Statistical methods, Specific yield, Water levels, Discharge (Water).
Identifiers: *USSR, Dzhezkazgan.

Pumping tests showed that the ratios between the well discharge and the level of the fissure-karst waters of the Dzhezhazgan region, USSR, are fairly complex. The following formulas were used: (1) The Dupuis for pressureless waters; (2) Krasnopol'skiy; (3) Keller; (4) Smreker; and (5) Al'tovskiy. Statistical analysis showed that: (1) Keller's parabolic relationship gave the most accurate results for prospecting wells; (2) Keller's formula was also best suited for computations of the specific discharges of prospecting and operational wells. Further discussion of other formulas is presented. (Carstea-USGS)
W70-03114

A REVIEW AND REVITALIZATION: CONCEPTS OF GROUNDWATER PRODUCTION AND MANAGEMENT--THE CALIFORNIA EXPERIENCE,
University of Southern California, Los Angeles. School of Law.
Robert I. Reis.
Natural Resources Journal, Vol 7, p 53-87, No 1, Jan 1967. 67 ref.

Descriptors: *Groundwater basins, *Legal aspects, California, Judicial decisions, Administrative agencies, Storage, Water supply.
Identifiers: Groundwater management.

The nature of legally protected interests in groundwater production must be redefined. In California, judicial allocation of water resources traditionally has been based on a limited natural supply. Imported water, by increasing the supply, brings this judicial approach into question. The most efficient method of meeting water requirements would be to pipe in imported water at a constant rate equal to base requirements, and to use the basin as a storage facility for peaking and cyclic needs. This method requires conceptual recognition of the basin as a place of storage. Section I highlights the evolution by which California water rights cases have projected protection of the basin's storage qualities. Three cases are analyzed in detail. Section II discusses the problems left unanswered by use of settlement agreements. Section III offers organizational alternatives for correcting settlement practices. Alternatives include open market allocation, regulatory controls, and state ownership and control. Private settlements have provided optimal conditions in the past, but future problems require coordinated dispensation of all available water source and storage facilities. Only a central agency can serve this need. (Gossen-Chicago)
W70-03145

SUBSURFACE AND PERCOLATING WATERS - WELL DRILLING.

N J Stat Ann secs 58:4A-1, 58:4A-2, 58:4A-4 to 58:4A-4.3 (1966) N J Stat Ann secs 58:4A-5, 58:4A-6, 58:4A-13, 58:4A-14, 58:4A-20 (Supp 1968).

Descriptors: *New Jersey, *Subsurface waters, *Well regulations, *Well permits, Legislation, Percolating water, Water resources, Administrative agencies, Regulation, Wells, Drilling, Legal aspects, Diversion, Withdrawal.
Identifiers: *Well sealing, Penalties (Civil).

A permit must be obtained from the Division of Water Policy and Supply of the State Department of Conservation to divert water from subsurface or percolating sources in excess of 100,000 gallons per day in areas delineated by said division where such diversion threatens to exceed the natural replenishment of such waters. Existing diversion of water at the time of this act or of the delineation of an area may be continued without a permit. Abandoned wells must be sealed and filled. The Division may order such sealing, and enforce such an order and any provisions of this act in the superior court. No person, partnership or corporation shall drill a well unless he is a licensed well driller. Operations on the drilling or construction of wells shall be under the immediate supervision of a licensed well driller. No well shall be drilled without a permit as required by this act. A report to the Department must be filed giving a description of wells drilled. The Division shall have power to investigate and inspect the construction and repair of wells throughout the state. Violations of this act are punishable by a fine of $100 to $250. (Sisserson-Florida)
W70-03180

GROUNDWATER RECHARGE THROUGH MODIFIED SHAFTS,
Agriculture Research Service, Bushland, Tex. Southwestern Great Plains Research Center.
D. C. Signor, V. L. Hauser, and O. R. Jones.
American Society of Agricultural Engineers, Transactions, Vol 12, No 4, p 486-489, 1969. 8 fig, 21 ref.

Descriptors: *Shafts (Excavations), *Groundwater recharge, *Aquifers, *Groundwater mining, *Recharge wells, Irrigated land, Groundwater, Surface runoff, Water table, Water resources, Agriculture, Evaporation, Piezometry, Overdraft, Hydraulic mining, Sands, Irrigation, Water quality, Turbidity, Texas, Playas, Drawdown.

Groundwater mining for irrigation from the Ogallala Formation under west Texas has caused serious decline in the water table - a common problem in arid and semiarid regions. Surface runoff from about 90% of the high plains of Texas, accumulating in natural depressions and playas, amounts to 2.5 to 3.0 million acre feet per year lost to evaporation. If this water could be diverted to recharge the aquifer, the agricultural life of the area could be prolonged and a reduced area of irrigated agriculture supported indefinitely. The authors report an experiment in which shafts were dug into the aquifer under a playa to recharge the aquifer. Observation wells and piezometers were also located in the area. Recharge rates through plain shafts ranged from 90 to 220 gallons per minute. A shaft modified by hydraulically mining a cavity deep in the aquifer sands increased recharge with clear water to 788 gallons per minute-a rate considered satisfactory. Some trouble was encountered with entrapped air at high recharge rates. It was also concluded that muddy water would have to be clarified before recharge to prevent aquifer surface plugging. The study has not continued long enough to determine what effects there may be from groundwater mounding under a recharge well. (Crouse-Arizona)
W70-03228

CONTRIBUTIONS ON THE STATUS OF ARID-LANDS RESEARCH: GROUNDWATER IN AUSTRALIA,
Arizona Univ., Tucson; and Army Natick Labs., Mass. Earth Sciences Div.
Eugene S. Simpson.
US Army Natick Laboratories, Earth Sciences Laboratory, Technical Report 70-5ES, 1969. 22 p, 52 ref. Contract No DAAG 17-67-C-0199.

Descriptors: *Arid lands, *Groundwater, *Groundwater basins, *Geologic investigations, *Rocks, Semiarid climates, Groundwater recharge, Groundwater reservoirs, Confined water, Hydrogeology, Geologic time, Mineral waters, Irrigation, Irrigation water, Crystalline rocks, Limestones, Sandstones, Sedimentary rocks, Groundwater mining, Wells logging (Recording), Sands, Aquifers.
Identifiers: *Australia, Porous rocks.

Since most of Australia is arid or semiarid, groundwater becomes extremely important. There is detailed knowledge of groundwater for small areas of the country, but for the most part the groundwater resources are known in only a very general basin-wide level. This report reviews the geology of Australia from the standpoint of aquifer characteristics of the rock structures. Water bearing rocks fall into three categories: (1) unconsolidated sediments, (2) porous rocks, and (3) fractured rocks. Most of the usable groundwater in arid Australia is contained in pore spaces of sandstones and limestones occurring in sedimentary basins which cover about one-half of the arid zone. These structures tend to be flat lying and are hundreds to thousands of feet in thickness, but are inter-layered with relatively impervious materials. This tends to produce artesian conditions in some places. The stored water has accumulated over geologic time and although great in quantity, is probably not being recharged at the rate of withdrawal for irrigation, livestock watering and domestic use. At least half of the groundwater supply is too mineralized for irrigation. In areas of crystalline rocks there are modest supplies of groundwater in the fractures or thin surface deposits of unconsolidated material. (Crouse-Arizona)
W70-03229

4C. Effects on Water of Man's Non-Water Activities

SALTWATER INTRUSION IN THE UNITED STATES,
American Society of Civil Engineers, New York. Hydraulics Div.
C. B. Sherwood, A. E. Bruington, and W. J. Drescher.
Proc Amer Soc Civ Eng, J Hydraul Div, Vol 95, No HY5, p 1651-1669, Sept 1969. 19 p, 1 tab, 7 ref, append.

Descriptors: *Encroachment, *Saline water intrusion, Groundwater, Salt water barriers, United States, *Saline water, Aquifers, Injection wells, Saline water-freshwater interfaces, Groundwater geology, Brine disposal, Underground water storage, *Salinity, *Sea water, Contamination, Brines, Water wells, Fresh water.

Salt-water intrusion into fresh groundwater formations is almost always the inadvertent result of some activity of man working to improve his environment. Three general mechanisms by which intrusion occurs are: (1) the reversal or reduction of groundwater gradients, allowing heavier saline water to move into an underground area where only fresh water existed before; (2) the accidental or inadvertent destruction of natural barriers that formerly prevented movement of salt waters or separated bodies of fresh and salt water; and (3) the accidental or inadvertent result of disposing of waste saline water. The occurrence of saline water is described in terms of geologic and hydrologic conditions. The extent of salt-water intrusion is given using a listing of 68 examples from throughout the United States. Statements are included regarding some areas where major control efforts are underway. (USBR)
W70-02940

A PROGRAM IN URBAN HYDROLOGY. PART II: AN EVALUATION OF RAINFALL-RUNOFF MODELS FOR SMALL WATERSHEDS AND THE EFFECTS OF URBANIZATION ON RUNOFF,
Purdue Univ., Lafayette, Ind. School of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-03035

EFFECTS OF CULTIVATION AND GRASS ON SURFACE RUNOFF,
Agricultural Research Service, Coshocton, Ohio. Corn Belt Branch.
For primary bibliographic entry see Field 03B.
W70-03088

PROBLEM OF ALLOWING FOR THE INFLUENCE OF AGRICULTURAL MELIORATION PRACTICES ON FLOW IN THE CONSTRUCTION OF A GENERAL PLAN FOR THE UTILIZATION AND PROTECTION OF THE WATER RESOURCES OF THE USSR,
B. B. Leont'yevskiy.
Transl from GGI, Sbornik Rabot po Gidrologii, No 8, p 58-66, 1968. Soviet Hydrology: Selected Papers, No 4, p 374-380, 1968. 3 tab, 12 ref.

Descriptors: *Water resources, *Water level fluctuations, *Agricultural watersheds, Watersheds (Basins), River flow, Forest management, Soil management, Soil conservation, Steady flow, Water management (Applied), Water conservation.
Identifiers: *USSR.

Two main opposing concepts regarding the influence of agricultural melioration practices on river flows are critically evaluated. These concepts are: (1) Agricultural and forest melioration practices do not reduce the normal flow to any significant extent; (2) the practices will change the water balance of the steppe and forest-steppe zones and the normal flow will decrease substantially. American data on the subject from the Mill Creek, Ohio, suggest that agricultural practices and an increase in yield will probably have no significant effect on the normal flow of large and medium rivers. More research in this field is strongly recommended. (Carstea-USGS)
W70-03110

CONSTRUCTION OF STATE HIGHWAY WHICH RESULTS IN DESTRUCTION OF WELL USED FOR POTABLE WATER SUPPLY.

NJ Stat Ann secs 27:7-21.1, 27:7-21.2 (1968-69 Supp).

Descriptors: *New Jersey, *Wells, *Highways, *Replacement costs, Cost repayment, Compensation, Costs, Cost sharing, Payment, Government supports, Construction costs, Reimbursable costs, Highway effects, Road construction, Water wells, Legislation, Legal aspects, Potable water.

Where a well providing an adequate supply of potable water is destroyed by the construction of a state highway and the construction of a new well is necessitated, the State Highway Commissioner may pay the owner of the well such portion of the cost of a new well as the Commissioner deems just or the cost of extending an existing municipal or private water main to the affected property. Payment is made only if a new well is actually constructed, and such payment shall never exceed the cost of construction. (Dye-Florida)
W70-03219

4D. Watershed Protection

MISSISSIPPI WATER RIGHTS LAW,
For primary bibliographic entry see Field 06E.
W70-02897

ACQUISITION OF LAND FOR PUBLIC RECREATIONAL PURPOSES - WATERSHED PROTECTION AREAS.
Wis Stat Ann secs 60.18 (15), 60.18 (21) (1957), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Watershed management, *Water resources, *Dam construction, Land, Legal aspects, Dams, Rivers, Recreation, Conservation, Natural resources, Land resources, Costs, Bodies of water, Public benefits, Financing, Local governments, Recreation facilities, Lake shores, Legislation.

At any annual town meeting the qualified electors may vote to authorize the town board to acquire land, river fronts, and lake shores for public use to construct and maintain dams within such tracts for recreational purposes, and to raise and expend money in developing watershed protection areas. (Casey-Florida)
W70-02913

SOIL CONSERVATION DISTRICTS LAW.
Ark Stat Ann sec 9-902 (1956), as amended, (Supp 1967).

Descriptors: *Arkansas, *Erosion control, *Erosion, *Soil conservation, Water loss, Legislation, Legal aspects, Soil erosion, Silting, Sedimentation, Streams, Channels, Reservoirs, Dams, Ditches, Harbors, Wildlife conservation, Navigation, Irrigation, Flood control, Water resources development, Land use.
Identifiers: Subsurface water loss, Corrective methods, Desilting basins.

Improper land-use practices continue to cause serious land erosion by water and wind. The consequences of such soil erosion include the silting and sedimentation of stream channels, reservoirs, dams, ditches, and harbors. Further consequences include water loss, fish loss, flooding, diminishing of the underground water reserve, and losses in navigation, municipal water supply, and irrigation developments. The corrective methods to conserve soil resources and prevent erosion include: appropriate soil conservation and land-use practices; structures for flood prevention, water development and conservation; construction of terraces, check dams, desilting basins, channel improvements, ponds and ditches; land drainage; land irrigation, the storage, transportation, and sale of water for irrigation, municipal or industrial water supply purposes; and a rural domestic water supply system. It is the policy of the legislature to provide for the foregoing corrective methods in order to preserve natural resources, control floods, prevent impairment of dams and reservoirs, assist in maintaining the navigability of rivers and harbors, and to accomplish other purposes. (Keith-Florida)
W70-02945

THE BENEFITS FROM WATERSHED DEVELOPMENT,
Soil Conservation Service, Washington, D.C.; Tennessee Valley Authority, Knoxville; and North Carolina State Univ., Raleigh.
For primary bibliographic entry see Field 06B.
W70-03018

APPLYING ECONOMIC PRINCIPLES IN WATERSHED PLANNING,
Department of Agriculture, Washington, D.C.
For primary bibliographic entry see Field 06B.
W70-03019

ORGANIZATION FOR WATERSHED PLANNING IN THE PUBLIC INTEREST,
Tennessee Valley Authority, Knoxville.
For primary bibliographic entry see Field 06B.
W70-03020

MULTIPLE PURPOSE LAND AND WATER DISTRICTS IN ONTARIO,
University of Western Ontario, London.
For primary bibliographic entry see Field 06B.
W70-03022

WATER, EARTH AND MAN: 3. HUMAN USE OF GROUNDWATER,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02F.
W70-03095

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

RADIOTRACER PROCEDURES FOR MECHANISTIC STUDIES IN AIR POLLUTION RESEARCH,
Bureau of Mines, Washington, D.C.
M. L. Whisman, and Basil Dimitriades.
Bur of Mines Report of Investigations Report RI-7304, Oct 1969. 36 p, 3 fig, 14 tab, 12 ref, 5 append.

Descriptors: *Air pollution, *Water pollution sources, *Radioactivity, *Tracers, *Smog, Trace elements, Atmosphere, Carbon, Statistical methods, Analytical techniques.
Identifiers: *Photochemical reactions (Smog).

Radiotracer techniques were developed for stoichiometric studies of photochemical reactions associated with atmospheric smog formation. Stock blends of separate hydrocarbon and oxygenated compounds were prepared and calibrated. C-14-labeled reactants and products in reaction systems involving hydrocarbons and nitrogen oxides at the ppm level were analyzed for qualitative and quantitative data. These methods developed for preparation and calibration of gas phase blends at a level of about 1000 ppm are applicable to low-molecular weight material (ethylene, butene) and to high-boiling materials such as m-xylene and mesitylene. Analytical methods developed for quantitative measurement of radioactivity products show the estimated precision level, with the exception of formaldehyde, plus or minus 2 percent. (Gabriel-USGS)
W70-02875

A REVIEW OF CHEMICAL MEASUREMENTS IN WATER POLLUTION CONTROL,
Federal Water Control Administration, Washington, D.C. Div. of Pollution Surveillance.
D. G. Ballinger.
Water and Sewage Works, p R38-R40, R42, 1968. 8 tab, 3 ref.

Descriptors: *Analytical techniques, *Water pollution control, *Water quality, Aquatic life, Chemical properties, Domestic water, Fish, Industrial water, Irrigation water, Livestock, Pesticides, Wastes, Wildlife, Water criteria.
Identifiers: Pollution parameters, Public water supply, Water quality parameters.

Selection of chemical parameters for use in evaluating water quality is discussed in relation to the desired water usage. Parameters required for fish, aquatic life and wildlife protection, and those necessary in the evaluation of waste loads are also reviewed. (Chalk-Wisconsin)
W70-02984

CLAY MINERAL STABILITY AND WATER COMPOSITION,
Washington State Univ., Pullman.
J. A. Kittrick.
Final Report for FWPCA Grant 16060 DGK, Nov 1969. 7 p, 1 fig.

Descriptors: Free energy, *Clay minerals, Soil chemistry, Soil water, Phase diagrams, Weathering, *Montmorillonite, *Illite.
Identifiers: Soil mineralogy, Soil solution, *Vermiculite, *Mineral.

The application of solubility methods to determining the standard free energy of formation of several soil minerals is summarized. Each of three illites and two vermiculites were found to be unstable relative to other minerals that form in the solution environment of soils and sediments. Illite may form in the ocean where muscovite is stable. Vermiculite derived from trioctahedral micas appears to be merely an unstable intermediate in all natural waters. Each of two montmorillonites were stable in water of specific compositions, as illustrated by a stability diagram. It is evident that minerals and the waters they contact interact to control aspects of each others composition.
W70-03026

EVALUATION OF WATER QUALITY TRENDS, SHENANDOAH RIVER, VIRGINIA, FRONT ROYAL TO BERRYVILLE,
Federal Water Pollution Control Administration, Charlottesville, Va. Middle Atlantic Region.
John W. Baumeister.
Federal Water Pollution Control Administration, Middle Atlantic Region Technical Report 2, Dec 1968. 14 p, 5 fig, 5 tab, 20 ref.

Descriptors: *Water quality, *Water pollution, *Rivers, Water chemistry, Water pollution sources, Phosphorus, Nitrogen compounds, Eutrophication, Productivity, Algae, Aquatic life.
Identifiers: Shenandoah River.

Physical and chemical data collected at the Berryville Surveillance Station were evaluated to determine pollution and eutrophication trends in the main stem of the Shenandoah downstream from Front Royal. Chemical quality was within the raw water criteria established for public water supplies; however, total phoshorus and nitrogen content of river water was sufficiently high to indicate a fertile stream capable of producing abundant aquatic organisms. Thirteen years of bottom samples collected over a 30 yr period in this reach show a gradual increase in the productivity of aquatic invertebrates. For the most part, these samples contained clean water and facultative forms which indicate the presence of relatively clean water. Phytoplankton numbers and population composition during the period 1962-1965 indicate a change from a diatom dominated population to one dominated by green algae. Nuisance algae were not

present in quantities sufficient to cause water treatment problems. (Knapp-USGS)
W70-03068

POLLUTION OF WATER BY MINERAL OIL; GAS CHROMATOGRAPHIC DETERMINATION OF OIL TRACES IN WATER (DUTCH),
R. Jeltes.
English summary. H2O, Vol 2, No 17, p 403-405, Aug 21, 1969. 3 p, 2 fig, 1 photo, 12 ref.

Descriptors: *Pollutant indentification, *Oily water, *Gas chromatography, Analytical techniques, Surface waters, Groundwater, Oil wastes, Industrial wastes.
Identifiers: Oil waste identification.

Contamination of surface and groundwater with mineral oil products is a matter of growing concern. This type of contamination may be detrimental for the quality of drinking water prepared from such waters. In the investigation of these pollutants, analytical chemical methods of determination are necessary. Attention is given principally to the determination of oil components in true solution (aromatic hydrocarbons), which are most detrimental. The method described is based on extraction of the oil from water and subsequent gas chromatographic analysis of the resulting extracts. Determination of the origins of oil components in water appears to be possible in certain cases. The method developed has been applied in the laboratory and in the field. (Knapp-USGS)
W70-03085

SOME PROBLEMS CONCERNING THE THERMAL REGIME OF RIVERS IN THE ARAKS BASIN,
S. M. Musayelyan.
Transl from GGI, Sbornik Rabot po Gidrologii, No 8, p 177-184, 1968. Soviet Hydrology: Selected Papers, No 4, p 408-414, 1968. 4 fig, 4 tab, 4 ref.

Descriptors: *Thermal pollution, *Water temperature, Gaging stations, Rivers, Watersheds (Basins), Heat flow, Air temperature, Hydrologic properties.
Identifiers: *USSR, Araks basin, Thermal regime.

The water temperature was measured at 67 gaging stations in the Araks River basin, USSR between 1950 and 1962. The data were used to determine: (1) the major patterns and characteristics of river water temperature, (2) annual and daily variation, (3) duration of periods of water temperature gradations, and (4) the heat flux. Two types of thermal regime can be distinguished: (1) Type I includes most of the rivers of the region and is characterized by water temperature variations as a function of air temperature; (2) Type II in which the thermal regime is affected by air temperature and by hydrogeological conditions of river feeding. There is a single maximum and a single minimum in the daily river water temperature. The water temperature increases along the rivers and the variations are significant along large rivers. (Carstea-USGS)
W70-03112

LAKE MICHIGAN OPEN WATER AND LAKE BED SURVEY 1968.
Illinois State Sanitary Water Board, Springfield.

Illinois State Sanitary Water Board, Report to the Governor and 76th General Assembly, Apr 1969. 36 p, 6 fig, 15 tab, 6 ref.

Descriptors: *Water quality, *Lake Michigan, *Illinois, *Water pollution, Coliforms, Bacteria, Phenols, Chlorides, Hydrogen ion concentration, Sulfates, Turbidity, Radioisotopes, Ammonium compounds, Nitrogen compounds, Phosphates, Lake beds, Pollution abatement.

During 1968, Illinois State Sanitary Water Board staff monitored Lake Michigan open water. Bottom samples were collected from a boat using sampling dredges. Results of chemical, bacteriological, phytoplanktor and physical examinations were compared to the Department of Interior Water Quality Standards approved in January 1968. Lake Michigan open water quality was judged to be in general compliance with the criteria for coliform bacteria, fecal streptococci bacteria, phenol-like substances, cyanide, chlorides, sulfates, pH, flourides, filterable residue, turbidity and radionuclides. Criteria for ammonia-nitrogen, phosphates, dissolved iron, and methylene-blue-active-substances were exceeded frequently at all of the intakes. Limited sampling and examination of bottom deposits and organisms indicated general compliance with the criteria, except within the breakwater at Calumet harbor and at the North Chicago sewage treatment works outfall. Action is being taken by the Illinois Sanitary Water Board, in conjunction with the other Lake Michigan states participating in two current Federal Enforcement Conferences, to further abate and to control pollution of the lake by discharges from municipal sewer systems, industries, watercraft and other sources. (Davis-Chicago)
W70-03140

5B. Sources of Pollution

ATTENUATION OF SELECTED NITROGEN FORMS BY SORPTION FROM AQUEOUS SOLUTION ONTO NATURAL SOILS,
Michigan State Univ., East Lansing. Coll. of Engineering.
Marvin E. Stephenson, and Raymond Rodrigue.
Available from the Clearinghouse as PB-188 961, $3.00 in paper copy, $0.65 in microfiche. Michigan State University Institute of Water Research, Completion Report, Apr 1969. 135 p, 10 fig, 1 tab, 87 ref, 3 append. OWRR Proj No A-22-MICH.

Descriptors: *Nitrates, *Adsorption, *Clays, *Soil chemistry, Thermodynamics, Path of pollutants, Laboratory tests, Expansive clays, Montmorillonite, Waste disposal, Water treatment, Anion adsorption, Ions, Ion exchange, Cation adsorption.
Identifiers: Nitrate adsorption.

The interaction of nitrates from agricultural waste disposal and other sources with soil materials was studied by equilibrating 200 solutions of nitrates with coarse-size Na and K montmorillonite particles. The literature on the physiological and chemical effects of nitrates is extensively reviewed and a bibliography is included. In the adsorption experiments, the equilibrium pH increased with increasing clay content. Increasing the nitrate concentration up to 32 mg/l caused an increase in the equilibrium pH when the average pH was greater than 8.9 and a decrease when the average pH was less than 8.9. Between 6 deg C and 35 deg C, nitrate anions, in the presence of either Na or K, were repelled from the surfaces of coarse montmorillonite particles whenever the equilibrium nitrate concentration was less than 20 mg/l and the equilibrium pH was between 4.5 and 10.2. Increasing the nitrate concentration reversed the initial increasing trend of the negative adsorption isotherms. (Knapp-USGS)
W70-02843

QUALITY OF WATER IN CHICKAMAUGA RESERVOIR.
Tennessee Valley Authority, Chattanooga. Environmental Hygiene Branch.

Stream Sanitation Staff Report, July 1964. 64 p, 24 fig, 8 tab, appendix.

Descriptors: *Recreation wastes, *Water pollution sources, Water pollution effects, Industrial wastes, Municipal wastes, Pollutant identification, Chemical analysis, Radioactivity, Water quality, Radioactive wastes, Recreation, Strontium, Ruthenium, Cesium, Cobalt, Reservoirs.
Identifiers: Marine craft pollution, Fecal coli, Non-fecal coli, Coliforms, Oak Ridge Atomic Plant, Clinch River (Tenn), Drinking water.

Water quality surveys of this 54 square mile reservoir revealed a significant correlation between discharge of industrial and domestic wastes and density of coliaerogenes, varying from less than 30 to many thousand organisms per 100 milliliter of water--far above drinking water standards. In most parts of the basin, fecal coli comprise a fraction of 1% of total number of coliforms, but the ratio constantly narrows by sewage discharged from towns and marine craft. Sanitary-chemical analyses of water quality included temperature, dissolved oxygen, biochemical oxygen demand, color, odor, and turbidity. Complete analyses of mineral composition were made during one year at monthly intervals. Reservoir receives fractions of the volume of certain low-level radioactive wastes discharged by the Oak Ridge Atomic plant into Clinch River, consequently determinations were made of the radionuclide concentration. Until November 1962, concentration of both cesium-137 and cobalt-60 was below detection limits. Average concentrations of strontium-90 and ruthenium-106 were below maximum allowable level, but in some weeks concentrations of either radionuclide exceeded permissible limits for drinking water. (Wilde-Wisconsin)
W70-02970

AGRICULTURAL CHEMICALS AND OUR WATER RESOURCES,
Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering; and Purdue Univ., Lafayette, Ind. Dept. of Entomology.
E. J. Monke, J. E. Fahey, and P. R. Goodrich.
Available from the Clearinghouse as PB-189 088, $3.00 in paper copy, $0.65 in microfiche. Paper presented at 1968 Annual Meeting of American Society for Engineering Education, California University, Los Angeles, June 17-20, 1968. 17 p, 36 ref. OWRR Proj No A-005-IND.

Descriptors: *Water pollution sources, *Water pollution effects, *Regulation, *Agricultural chemicals, *Reviews, Bibliographies, Pesticides, Fertilizers, Organic matter, Nutrients, Eutrophication, Nitrogen compounds, Legislation, Farm management, Land management.
Identifiers: Agricultural effects (Water quality).

Literature pertaining to the effects of agricultural chemicals on water resources was reviewed. An attempt is made to put the contribution of chemicals from agricultural sources in proper perspective and to predict the effect of increasing regulation on the use and methods of application of agricultural chemicals. Proper management of agricultural chemicals from profit and safety motives alone would reduce the levels of unwanted chemicals reaching water supplies. Much greater research effort is needed in all phases of pollution reduction. In general, engineering education should be more concerned with the environment, its measurement and control. (Knapp-USGS)
W70-03065

TEMPERATURE AND TURBULENCE EFFECTS ON THE PARAMETER (DELTA) IN THE STOCHASTIC MODEL FOR BOD AND DO IN STREAMS,
Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center; Virginia Polytechnic Inst., Blacksburg. Dept. of Sanitary Engineering; and Virginia Polytechnic Inst., Blacksburg. Dept. of Statistics.
For primary bibliographic entry see Field 05C.
W70-03066

EVALUATION OF ALTERNATIVE SOLUTIONS FOR ACHIEVEMENT OF RIVER STANDARDS,
Quirk, Lawler and Matusky, New York.
Thomas P. Quirk, and Leonard J. Eder.
Proc, Sixteenth Southern Water Resources Pollut Contr Conf, Duke Univ, p 33-54, Apr 1967. 22 p, 11 fig, 3 tab.

Descriptors: *Water quality control, *Mathematical models, *Simulation analysis, *Biochemical ox-

ygen demand, *Dissolved oxygen, Waste disposal, Waste assimilative capacity, Flow augmentation, Alternative costs, River basins, Temperature, Economics, Standards, Evaluation.

A river of approximately 170 miles in length, with a drainage area of 3,500 square miles was studied. The objectives of the study included; (a) determination of the river's physical characteristics; (b) development of a mathematical simulation model of the river to predict the biochemical oxygen demand (BOD) and dissolved oxygen (DO) profiles under any condition of flow temperature or waste discharges; (c) application of the simulation model to investigate in detail the BOD assimilation capacity under critical weather and flow conditions and the effects of sludge deposits, hydroturbine venting and flow augmentation and; (d) development of the comparative economics of alternative solutions for achievement of proposed water quality standards. The river model was used for the development of the effects on water quality anticipated from the solution components available as well as combination of solutions which appeared practical and economically attractive. (Thiuri-Cornell)
W70-03165

WATER QUALITY PLANNING IN THE PRESENCE OF INTERACTING POLLUTANTS,
Clemson Univ., S.C. Dept. of Environmental Systems Engineering.
Benjamin C. Dysart, III.
42nd Annu Conf, Water Pollut Contr Federation, Dallas, Texas, Oct 1969. 39 p, 18 fig, 2 tab, 15 ref.

Descriptors: *Mathematical models, *Optimization, *River basins, *Water pollution control, *Dissolved oxygen, Temperature, Decision making, Planning, Management, Economic feasibility, Water quality, Standards.

A mathematical optimization model was developed and used to; (a) demonstrate a methodology for water quality planning and management for the interaction of pollutants in the stream, and (b) to minimize total river basin pollution control costs associated with maintaining specific dissolved oxygen (DO) and temperature standards. The Chattahoochee River basin was studied. The study showed that optimal system cost would be most effected by changes in DO standards. Very high DO would be economically prohibitive decreases in temperature standards would be relatively inexpensive. Increases in temperature standards would result in only slight savings for abatement facilities. This type of economic analysis made it possible to compare alternative sets of water quality standards on a common, rational basis for cost affectiveness. It also provided guidance to policy makers. (Thiuri-Cornell)
W70-03168

CONTROL OF WATER QUALITY IN A COMPLEX NATURAL SYSTEM,
Clemson Univ., S.C. Dept. of Environmental Systems Engineering; and Georgia Inst. of Tech., Atlanta.
Benjamin C. Dysart, III and William W. Hines.
IEEE Syst Sci Cyberneties Conf Rec, Phila, p 70-81, Oct 1969. 12 p, 9 fig, 3 tab, 18 ref.

Descriptors: *Water quality control, *Dynamic programming, *Biochemical oxygen demand, *Dissolved oxygen, *Temperature, Constraints, Streams, Thermal pollution, Organic wastes, Systems analysis, Water quality, Standards.

An approach to water quality control was presented for the case where there would be significant interaction of wastes in a stream. In most previous studies, a single pollutant was considered and a single related parameter used as a constraint. The specific pollutants selected for study in the investigation were; (a) biochemical oxygen demand (BOD) and (b) thermal wastes or heat. The related water quality standards were (a) dissolved oxygen concentration (DO), (b) maximum allowable stream temperature, and (c) allowable use in stream temperature. The Chattahoochee River, a free flowing stream which receives thermal and organic wastes was modeled as an N-stage serial system. Two-dimentional dynamic programming technique was used to determine minimum-cost control policies. The response of total system cost and control policy to variation of quality standards was presented. (Thiuri-Cornell)
W70-03170

TRANSPORT OF DISSOLVED WASTES IN RIVERS,
Federal Water Pollution Control Administration, Washington, D.C.; and Texas Univ., Austin. Center for Research in Water Resources.
Roger Don Shull, and Earnest F. Gloyna.
J Sanit Eng Div, ASCE, Vol 95, No SA6, p 995-1012, Dec 1969. 18p, 9 fig, 9 ref, 1 append.

Descriptors: *Mathematical models, *Simulation analysis, *Stochastic processes, *River systems, *Environmental affects, Sorption, Digital computers, Channel flow, Downstream, Flow measurement.
Identifiers: Waste transport, Waste release.

Transport of dissolved radioactive and other tonic wastes was simulated on a digital computer for demonstrating possible environmental effects of wastes discharged to rivers in low concentrations over several decades. The mathematical model was based on experimental aquarium and river model data which was sealed to prototype parametric values. Waste transport in large unregulated rivers was simulated over long distances for periods of many years. River simulation included monthly stochastic flow variation flooding, variable channel shape, tributary flow, sorption of wastes by stationary components of the benthal systems, and erosion of the benthal at high flows. Large variations in downstream waste transport rates in river receiving a constant, continious waste release were shown to be a function of channel sorption of wastes, flow variability, and benthal erosion resistance. (Thiuri-Cornell)
W70-03174

5C. Effects of Pollution

MICRONUTRIENT REQUIREMENTS FOR GREEN PLANTS, ESPECIALLY ALGAE,
Charles F. Kettering Research Lab., Yellow Springs, Ohio.
Clyde Eyster.
Algae and Man, Jackson, Daniel F, editor, Plenum Press, NY, p 86-119, 1964. 11 fig, 2 tab, 174 ref.

Descriptors: *Nutrient requirements, *Plant growth, *Algae, Elements (Chemical), Chlorophyta, Cyanophyta, Chlorella, Manganese, Photosynthesis, Oxygen, Carbon dioxide, Scenedesmus, Chlorophyll, Iron, Chelation, Enzymes, Chlorine, Light intensity, Nitrate, Euglena, Calcium, Ammonium salts, Nitrogen fixation, Boron, Azotobacter, Molybdenum, Cobalt, Copper, Sodium, Magnesium, Potassium, Sulfur, Phosphorus, Hydrogen.
Identifiers: Macronutrients, Micronutrients, Chlorella pyrenoidosa, Autotrophic growth, Heterotrophic growth, Ankistrodesmus, Nostoc muscorum, Scenedesmus obliquues, Scenedesmus quadricauda, Porphyridium cruentum, Lemna minor, Photophosphorylation, Vanadium, Zinc, Euglena gracilis, Anabaena cylindrica, Bacillus subtilis, Aspergillus oryzae niger, Silicon, Phanerogams.

Five elements, manganese, iron, chlorine, zinc, and vanadium are generally required by algae and green plants for photosynthesis. Manganese and chlorine have a role in oxygen evolution. Vanadium accelerates photosynthesis under high light intensity but this effect has been reported only for Scenedesmus obliquus and Chlorella. Iron is the metal part of at least two plant cytochromes which occur in the chloroplasts of green cells and probably facilitates transfer of electrons during photosynthesis. Role of zinc in photosynthesis is uncertain; it may aid in hydrogen transfer since sinc is known to be the metal constituent of various dehydrogenases. Nitrogen fixation in algae having the capacity to fix gaseous nitrogen, requires the following elements: boron, calcium, iron, molybdenum, and perhaps cobalt; these elements may be required for one or more other functions. Critical concentration of an element for its two or more functions is usually much higher for nitrogen fixation. Algae which are forced to fix nitrogen have high boron and calcium requirements. Place of cobalt utilization is uncertain. Some evidence indicates that small concentrations of manganese, calcium, boron, cobalt, copper, and silicon are required for other metabolic functions. (See Vol 2, No 19, Field 5C, entry W69-07832). (Jones-Wisconsin)
W70-02964

ENVIRONMENTAL CONDITIONS AND THE PATTERN OF METABOLISM IN ALGAE,
Westfield Coll., London (England). Dept. of Botany.
G. E. Fogg.
Algae and Man, Daniel F. Jackson, editor, Plenum Press, NY, p 77-85, 1964. 22 ref.

Descriptors: *Algae, *Metabolism, *Environments, Variability, Chlorella, Carbon, Temperature, Light intensity, Nutrient requirements, Nitrogen, Nitrogen fixation, Photochemical, Carbon dioxide, Synthesis, Enzymes, Chlorophyta, Rhodophyta, Scenedesmus, Chlamydomonas, Ecology, Phosphorus, Sulphur, Hydrogen ion concentration, Time.
Identifiers: Botryococcus braunii, Metabolic pattern, Anabaena cylindrica, Glycolysis, Tricarboxylic acid cycle, Autoradiography, Monodus subterraneus, Navicula pelliculosa, Xanthophyceae, Bacillariophyceae, Nitzschia palea, Myxophyceae, Chlamydomonas moewussi, Fat accumulation.

A single strain of algal specie may show remarkable variations in intensity and pattern of its metabolic activities, depending on exposure conditions. Effects of light intensity, temperature, and hydrogen ion concentration on rates of individual metabolic processes and on their final growth in cell numbers are known, yet the differential effects that these conditions may have on different processes are largely unknown. Time factor is significant; temperature changes may produce marked alterations in the balance of major anabolic algal processes. Availability of metabolites may affect metabolic pattern, apart from changes on overall metabolic rate. In algal populations growing exponentially, synthesis of proteins and other protoplasmic constituents predominate and directly utilize intermediates of the photosynthetic carbon cycle. A similar effect is perhaps involved in excretion of glycolic acid from photosynthesizing cells. Algae is able to produce adaptive enzymes and metabolic pattern is determined primarily by relative activities of the various enzyme systems. It is unclear whether fat accumulation in nitrogen-deficient cultures results from halting of the developmental cycle at a point at which fat synthesis predominates. Factors affecting fat accumulation are discussed. (See Vol 2, No 19, Field 5C, entry W69-07832). (Jones-Wisconsin)
W70-02965

A PRELIMINARY BIBLIOGRAPHY ON EXTENT AND CAUSES OF EARLY MORTALITY IN FRESHWATER FISH (DIADROMOUS FISHES EXCLUDED),
Utah State Univ., Logan. Utah Cooperative Fishery Unit.
Robert H. Kramer.
Food and Agriculture Organization of the United Nations, Rome, FAO Fisheries Circular No 307, Jan 1969. 20 p, 191 ref.

Descriptors: *Bibliographies, *Freshwater fish, *Mortality, *Fish, *Juvenile fishes, Environmental effects, Fishkill, Water pollution effects, Fish populations, Lampreys, Salmonids, Wind, Piles, Waves (Water), Minnows, Temperature, Catfishes, Killifishes, Diseases, Sunfishes, Dissolved oxygen, Bass, Foods, Perches, Fungi, Darters, Behavior, Hydrogen sulfide, Groundwater, Light, Salinity, Predation, Water levels, Radiation.
Identifiers: Sturgeons, Paddlefish, Osmerid fishes, Goldeyes, Persopsid fishes, Sciaenid fishes, Atherinid fishes, Bottom type, Commensal spawning, Morphology, Population density, Siltation, Cannibalism.

Published data overwhelmingly support the hypothesis that strength of year-class in freshwater fishes is established very early in their life history, often prior to the completion of the larval period. This preliminary bibliography, comprising some 191 entries, documents this hypothesis. It was compiled for circulation among specialists, with objective of soliciting for suggestions, corrections, and additons. Citations are largely from the English-language literature published between 1886 and 1968, of which approximately 51% were published in the decade beginning 1960. The following headings are included in a subject index (with number of citations pertaining to each indicated in parentheses): Behavior (8); bottom type (6); commensal spawning (6); disease (3); dissolved oxygen (15); food (16); fungus (3); groundwater (2); hydrogen sulfide (2); light (10); morphology (5); pollution (15); population density (2); predation and cannibalism (21); radiation (2); salinity (1); siltation (4); water level (18); water temperature (48); wind and wave action (6). A species index is also provided. (Eichhorn-Wisconsin)
W70-02966

CALORIC AND CARBON EQUIVALENTS OF ZOOPLANKTON BIOMASS,
Fisheries Research Board of Canada, Dartmouth (Nova Scotia). Marine Ecology Lab.
For primary bibliographic entry see Field 02L.
W70-02967

THE ORIGIN AND QUANTITIES OF PLANT NUTRIENTS IN LAKE MENDOTA,
Wisconsin Univ., Madison.
Gerard A. Rohlich, and William L. Lea.
Lake Investigations Committee Report, Wisconsin Univ, Madison, 1949. 8 p, 6 tab.

Descriptors: *Eutrophication, *Agricultural wastes, *Algae, *Lakes, *Tributaries, Sampling, Flow, Analysis, Fertilization, Plant growth substances, Sewage, Sulfate, Manganese, Iron, Carbon dioxide.
Identifiers: *Inland, Horizontal sampling, Vertical sampling, Lake Mendota (Wis), Lake Monona (Wis), Lake Waubesa (Wis), Lake Kegonsa (Wis), Weed beds, Phosphorus, Nitrogen balance.

To obtain a comprehensive picture of eutrophication dynamics of Lake Mendota, Wisconsin, three series of stations--inland, horizontal, and vertical--were established on the lake and its tributaries. Analyses of samples collected at inland stations enabled determination of nutrients retained in the lake. Sampling stations of the horizontal series formed transects from upper parts of streams to their mouths and into the lake. These stations provided information on the modification of original nutrient concentration by weed beds and algae. Vertical series stations were located in two 65-foot-deep and one 80-foot-deep holes. Sampling of three water horizons--surface, thermocline at 10 meters, and about 0.5 meters above the bottom--aimed to reveal variation in nutrient concentration and aquatic biomass with depth. Lake's inflow-outflow balance constituted 130 plus or minus 1.2 cubic feet/second. Analyses of chemical factors included pH, alkalinity, dissolved oxygen, biochemical oxygen demand, soluble phosphorus, total phosphorus, free ammonia nitrogen, total organic nitrogen, nitrite, nitrate, sulfates, silicates, manganese, and iron. During the year 17,460 pounds soluble phosphorus entered the lake, the amount corresponding to an application of 1.8 pounds/acre of lake surface. Enrichment in organic nitrogen, largely in nitrate form, amounted to 259,720 pounds, equivalent to fertilization of 26.7 pounds/acre. (Wilde-Wisconsin)
W70-02969

SEASONAL DISTRIBUTION, CONSTITUTION, AND ABUNDANCE OF ZOOPLANKTON IN LAKE ERIE,
Memorial Univ. of Newfoundland, St. Johns. Marine Sciences Research Lab.; and Memorial Univ. of Newfoundland, St. Johns. Dept. of Biology.
Charles C. Davis.
Journal Fisheries Research Board of Canada, Vol 26, No 9, p 2459-2476, 1969. 5 tab, 14 ref.

Descriptors: *Distribution patterns, *Lake Erie, *Zooplankton, Daphnia, Cyclops, Rotifers, Protozoa.
Identifiers: Asplanchna, Bosmina, Ceriodaphnia, Chydorus, Cladocera, Cyclops, Diaptomus, Holopedium, Keratella, Mesocyclops, Polyarthra, Tropocyclops, Lake Erie Basins.

Distribution, constitution, and abundance of zooplankton in Lake Erie are given on the basis of vertical zooplankton hauls from 28 stations. Among Protozoa, Vorticella, Epistylis, and Codonella were dominant in West Basin in October 1967; Codonella being also abundant in Central and East Basins with Epistylis occurring minimally. In January 1968, Vorticella was abundant in West and Central Basins, Codonella occurring in smaller numbers. Among larger zooplankton at least 15 species (9 genera) of rotifers, 9 species (7 genera) of cladocerans and 13 species (7 genera) of copepods were encountered. Distinct differences in zooplankton populations occur in the three basins of the lake. October biomass of cladocerans and copepods was greatly reduced as compared with July. Among cladocerans Bosmina coregoni occurred mainly in East and Central Basins; B longirostris was more abundant in Western Basin. Copeopd populations of Western Basin were greatly impoverished as compared with other basins. Ratios of seston, chlorophyll a and phytoplankton among three basins exhibited a progressive decrease from west to east. A possible instance of winterkill of microcrustacea was noted in January 1968. (Voigtlander-Wisconsin)
W70-02971

PRELIMINARY INVESTIGATION OF THE EXPLOITATION OF SOME POTENTIAL NUTRITIONAL RESOURCES BY THREE SYMPATRIC TUBIFICID OLIGOCHAETES,
Toronto Univ. (Ontario). Dept. of Zoology.
Ralph O. Brinkhurst, and Kian E. Chua.
Journal Fisheries Research Board of Canada, Vol 26, No 10, p 2659-2668, 1969. 2 fig, 3 tab, 24 ref.

Descriptors: *Lake Ontario, *Oligochaetes, *Tubificids, Amino acids, Bacteria, Detritus, Water pollution.
Identifiers: *Nutritional resources, *Toronto Harbor (Canada), *Tubifex, Glycine, Nutrient uptake, Limnodrilus, Peloscolex, Saginaw Bay (Michigan), Lake Huron.

Three species of tubificids (Tubifex tubifex, Limnodrilus hoffmeisteri, Peloscolex multisetosus) characteristic of areas polluted by high amounts of organic matter were studied to determine their utilization of heterotrophic bacteria and glycine. Eight species of bacteria were cultured from mud samples taken from Toronto Harbor. Seven bacteria developed at any one time, with Chromobacterium and Aeromonas alternating in the samples. Peloscolex gut contents yielded all seven species of bacteria; Limnodrilus and Tubifex did not contain Aeromonas; Pseudomonas was absent from Tubifex. Laboratory cultures of worms indicated only one bacterial species survived passage through guts, a different bacterium for each tubificid. Studies on uptake of C-14 tabelled glycine indicated insignificant uptake by Tubifex and Limnodrilus. Significant uptake was demonstrated in Peloscolex, glycine being concentrated in the chloragogen surrounding the intestine. Results may indicate differences in utilization of potential nutritional resources by the three species. Free organic matter and microflora available as food for detritus feeders may be more relevant to their ecology than more commonly investigated physical and inorganic factors. Tabular data include results of bacterial identifications from filed and laboratory studies. (Voigtlander-Wisconsin)
W70-02972

IN VITRO RESPONSES OF SOFT WATER ALGAE TO FERTILIZATION,
Ontario Water Resources Commission, Toronto. Div. of Research.
A. E. Christie.
Division of Research Paper No 2024, Aug 1969. 16 p, 2 fig, 4 tab, 9 ref.

Descriptors: *Bioassay, Phytoplankton, Lakes, Eutrophication, Sampling, Surfaces waters, Carbon, Fertility, Algae, Nitrogen, Phosphorus, Water pollution effects.
Identifiers: *Twelve Mile Lake (Canada), *Ontario, *Canada, Nutrient levels, Soft water.

A 'preliminary' single sample from oligotrophic Twelve Mile Lake, Ontario, was bioassayed by spiking with sodium bicarbonate, potassium nitrate, and potassium dihydrogen phosphate, or combinations of these compounds. Bottles were carried 21 days at 20 C under a diurnal cycle of 14 hours light and 10 hours dark under the extremely high light intensity of 4000-foot-candles. The sample's indiginous population served as the assay response organisms, and were measured by Areal Standard Units. The only response by the algae in the sample was to a combination of nitrogen and phosphorus. (Gerhold-Wisconsin)
W70-02973

COMPOSITION AND HORIZONTAL DISTRIBUTION OF CRUSTACEAN PLANKTON IN LAKE ONTARIO,
Fisheries Research Board of Canada, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 02H.
W70-02975

DO MARINE CRUSTACEANS RELEASE DISSOLVED AMINO ACIDS,
Virginia Inst. of Marine Science, Gloucester Point; and Georgia Univ., Athens. Dept. of Zoology.
Kenneth L. Webb, and R. E. Johannes.
Comparative Biochemistry and Physiology, Vol 29, p 875-878, 1969. 11 ref.

Descriptors: *Crustaceans, *Marine animals, *Amino acids, Bacteria, Ammonia, Nitrogen, Phosphorus, Invertebrates, Incubation, Amphipoda, Copepods, Metabolism, Density.
Identifiers: *Amino acid release, Calanus helgolandicus, Calanus chilensis, Palaemonetes pugio, Bacterial action.

Marine bacteria multiply rapidly within a few hours when sea water is enclosed in containers, increasing in numbers by several orders of magnitude. Many species of heterotrophic marine bacteria whose nutrient requirements have been published have been shown to require one or more amino acids for maximum growth. Surfaces of zooplankters and their fecal pellets provide abundant seed of bacteria in incubation vessels. For this reason, incubation times should be held to a minimum to avoid serious loss of amino acids from solution. The new experiments described indicate the general effect bacteria have on dissolved amino acid levels during prolonged incubations. Previous workers give tables in which all eight species of aquatic crustaceans cited were found to release dis-

solved amino acids. Serious errors arise in the measurement of release of dissolved amino acids by marine animals if incubation times exceed a few hours. Longer incubation periods allow bacteria to reach high densities and to remove significant quantities of amino acids from solution. This probably explains the conflict between researchers who find that marine crustaceans release dissolved amino acids and those who fail to detect this release. (Jones-Wisconsin)
W70-02976

ARE DISSOLVED AMINO ACIDS AN ENERGY SOURCE FOR MARINE INVERTEBRATES,
Georgia Univ., Athens. Dept of Zoology; and Virginia Inst. of Marine Science, Gloucester Point.
R. E. Johannes, S. J. Coward, and K. L. Webb.
Comparative Biochemistry and Physiology, Vol 29, p 283-288, 1969. 1 tab, 30 ref.

Descriptors: *Marine animals, *Invertebrates, *Amino acids, *Energy, Radioactivity techniques, Organic compounds, Carbon radioisotopes, Georgia, Salinity, Sea water, Biological membranes.
Identifiers: Amino acid uptake, Release, Bdelloura candida, Specific activity, Sapelo Island (Georgia), Microbial contaminants, Marine invertebrates, Amino acid loss, Putter's theory.

Marine invertebrates possess high concentrations of free amino acids (FAA) in their tissues several orders of magnitude higher than FAA levels in sea water. Labeled FAA entering these animals are presumably diluted with large endogenous unlabeled FAA pools with resulting pronounced decrease in specific activity. Subsequent release of labeled FAA from the animals into the medium in quantities that are small relative to the amounts of uptake cannot be assumed to indicate that the amount of unlabeled FAA released is also small. A unit of carbon-14-labeled FAA moving out of the animals will represent the flux of a greater quantity of unlabeled FAA than a unit of carbon-14 moving into them. Removal of radioactively labeled organic compounds from solution by marine invertebrates does not constitute proof of net uptake of these compounds. Observations on uptake of carbon-14-labeled dissolved FAA and the release of total dissolved FAA by Bdelloura candida, indicate the net flux of these compounds is outside the animal. Evidence is discussed indicating that there is a net loss of dissolved FAA by various other marine invertebrates. (Jones-Wisconsin)
W70-02977

MOULTING OF EUPHAUSIA PACIFICA AS A POSSIBLE MECHANISM FOR VERTICAL TRANSPORT OF ZINC-65 IN THE SEA,
Oregon State Univ., Corvallis. Dept. of Oceanography.
Scott W. Fowler, and Lawrence F. Small.
International Journal of Oceanology and Limnology, Vol 1, No 4, p 237-245, 1967. 3 tab, 10 ref.

Descriptors: *Zinc radioisotopes, *Oceans, Pacific Ocean, Plankton, Migration patterns, Temperature, Salinity, Nuclear explosions, Nuclear reactors, Retention, Oregon, Columbia River, Radioactivity, Sampling, Adsorption, Depth, Surface waters, Columns, Phytoplankton, Food webs, Pollution, Euphausiids.
Identifiers: *Euphausia pacifica, *Vertical transport, *Moulting, Exoskeletons, North Pacific Ocean, Pycnocline, Uptake, Richland (Washington), Specific activity, Halocline, Exuvia, Hanford Nuclear Reactors.

In large concentrations of zinc-65, exoskeletons of Euphausia pacifica accumulate substantial loads of the isotope. As E pacifica is an abundant vertical migrant in North Pacific, moulting approximately every five days, heavy zinc-65 accumulation in exoskeletons could be a major mechanism of vertical transport of the isotope. Moulted exoskeletons averaged 41% of total body activity prior to moulting in uptake experiments, and in loss experiments 18%. Percentage loss from animals alternately accumulating and losing activity was about 30%. Zinc-65 activity in case exoskeletons correlated roughly with whole body activity before moulting, but apparently was not correlated with water temperature, animal size, or initial zinc-65 concentration. Lack of correlation with these factors probably was due partially to exoskeleton size differences and exuvia removal from experimental flasks at only 24-hour intervals. Zinc-65 loss rates from animals via moulting were computed for three hydrographic conditions common in North Pacific. Assuming same concentrations of zinc-65 under these conditions, highest loss rate was in a well-mixed water column (zinc-65 homogeneously distributed), lowest rate when zinc-65 was distributed above a pychocline in summer. Sinking of radioactive exuvia and ingestion of exuvia by other organisms is discussed. (Jones-Wisconsin)
W70-02978

GROWTH RATE AND BODY COMPOSITION OF FINGERLING SOCKEYE SALMON, ONCORHYNCHUS NERKA, IN RELATION TO TEMPERATURE AND RATION SIZE,
Fisheries Research Board of Canada, Nanaimo (British Columbia). Biological Station.
J. R. Brett, J. E. Shelbourn, and C. T. Shoop.
Journal Fisheries Research Board of Canada, Vol 26, No 9, p 2363-2394, 1969. 17 fig, 8 tab, 49 ref, appendix A, B.

Descriptors: *Growth rates, *Sockeye salmon, Efficiencies, Feeding rates, Food abundance, Maintenance, Temperature, Sampling, Fish.
Identifiers: Body composition, Calorific values, Gross efficiency, Net efficiency, Oncorhynchus nerka, Bioenergetics, Experimental tanks.

Growth of fingerling sockeye salmon was studied under controlled laboratory conditions at temperatures of 1, 5, 10, 15, 20 and 24 C in relation to artificial rations of 0, 1.5, 3, 4.5 and 6% of dry body weight/day and at excess rations. Optimum growth occurred at about 15 C for two highest rations and shifted progressively to lower temperatures at each lower ration. Maximum growth rates varied from 2.6% per day (5-7 month-old fish) to 1.6% per day (7-12 month-old fish). Maintenance requirement varied from approximately 0.4% weight/day at 1 C to 4% at 23 C, rising rapidly above 12 C. Curves relating ration and growth rate were logistic for 20 C and geometric at lower temperatures. No growth was noted at 23 C under excess rations. Calculated isopleths indicated maximum gross efficiency of 25% at 11.5 C and 4% weight/day ration and maximum net efficiency of 40% in the range 8-10 C and 0.8 (maintenance level) to 1.5% weight/day ration. Proximate analyses revealed ranges of water, protein, and fat from 86.9, 9.4, and 1.0% respectively at 20 C after 83 days starvation to 71.3, 19.7 and 7.6% at 15 C and excess rations. (Voigtlander-Wisconsin)
W70-02979

ACUTE TOXICITY OF ZINC TO THE KILLIFISH, FUNDULUS HETEROCLITUS,
Bureau of Sport Fisheries and Wildlife, Highlands, N.J. Fish-Pesticide Research Lab.
Ronald Eisler.
Chesapeake Science, Vol 8, No 4, p 262-264, 1967. 2 fig, 9 ref.

Descriptors: *Toxicity, *Killifishes, Salinity, Hydrogen ion concentration, Temperature, Spectroscopy, Marine fish, Freshwater fish, Estuarine environment.
Identifiers: *Zinc, *Fundulus heteroclitus, Gill arch, Liver.

During preliminary experiments on effects of sublethal concentratns of insecticides to marine organisms, it was observed that zinc and other metals accumulate in selected tissues of several species. Quantitative date on zinc toxicity to marine fishes were lacking. Effects of different levels of sinc in seawater on the mummichog were explored. Groups of adult Fundulus heteroclitus were subjected to varying concentrations of zinc as zinc chloride at 24 parts/thousand salinity, pH 8.0 and 20 C. At 192 hours, all mummichogs exposed to 43 parts/million or less of zinc were alive and externally indistinguishable from the controls. There were no appreciable differences of zinc content in various tissues, (determined by atomic absorption spectroscopy) regardless of the initial amount of zinc in solution. All mummichogs subjected to 157 parts/million or 180 parts/million of zinc died between 24 and 48 hours. Dead mummichogs were separated into liver, gill arch, and remainder (primarily carcass); they contained about 7 and 8 times more zinc in whole fish and in gill arch, respectively, than controls, thus providing an index of sinc-caused mortality for the species. (Jones-Wisconsin)
W70-02980

THE ECOLOGY OF A DIATOM COMMUNITY IN A THERMAL STREAM,
Washington Univ., Seattle. Dept. of Zoology; and Freshwater Biological Association, Ambleside (England).
John G. Stockner.
British Phycological Bulletin, Vol 3, No 3, p 501-514, 1968. 5 fig, 4 tab, 26 ref.

Descriptors: *Physiological ecology, *Diatoms, *Thermal water, *Streams, Nutrients, Bioindicators, Phosphates, Nitrates, Bicarbonates, Hot springs, Hydrogen ion concentration, Thermal pollution, Alkalinity, Carbonates, Conductivity, Iron, Sodium, Sedimentation, Cores, Potassium, Epiphytes, Magnesium, Paleoecology, Sulfates, Washington, Chlorides, Water chemistry, Water pollution.
Identifiers: *Thermobiology, Epipetic flora, Total dissolved solids, Rhopalodia, Denticula, Mastogloia, Amphora, Navicula, Nitzschia, Caloneis, Diploneis, Surirella, Photobiology, Seasonal effects, Anomoeoneis, Epithemia, Gomphonema, Pinnularia, Achnanthes, Phosphorus (Total), Mount Rainier National Park, Ohanapecosh Hot Springs (Wash), Oedogonium.

The structure of diatom communities has been used as a bioindicator of manmade river pollution. Suitable parameters of community structure include a species diversity index derived from the Shannon-Wiener information function (H, the negative summed product, for species 1 to s, of proportion of each species by its natural logarithm) and the redundancy, a measure of degree of repetitious counting ($R = 1 - H/\ln s$). Community structures of diatoms in stream draining one of the Ohanapecosh Hot Springs, Washington, were examined during 1964-1967. Despite large seasonal changes in abundance and shifts in species composition, values for H generally did not deviate significantly from the mean, such relative constancy being interpretable as an indication of community stability. The conclusion is that stream strikingly resembles culturally polluted waters and characteristic pattern of species abundance is attributed to their light adaptation. Three cores, obtained from the soft sediments of the spring, were analyzed for diatom remains. Cores were dated on the basis of a pumice layer of known age, and interpretations bearing on paleoecology of the diatom community added a significant temporal dimension to annual analyses. (Eichhorn-Wisconsin)
W70-02981

OXIDATION REACTIONS OF NITROGEN IN WATER RECEIVING SECONDARY TREATMENT PLANT EFFLUENTS,
Cornell Univ., Ithaca, N.Y. Water Resources and Marine Sciences Center.
Charles D. Gates.
Available from the Clearinghouse as PB-189 044, $3.00 in paper copy, $0.65 in microfiche. Cornell University Water Resources and Marine Sciences Center Technical Report No 15, June 1969. 15 p, 3 fig, 3 tab, 39 ref. OWRR Project A-012-NY.

Descriptors: *Biochemical oxygen demand, *Oxidation, *Nitrification, *Biodegradation, *Nutrients, Waste disposal, Sewage effluents, Laboratory tests, Waste dilution, Water quality.
Identifiers: Biological treatment plant effluents, Effluent oxidation.

Microbiological and engineering studies on the oxidation or inorganic nitrogen in controlled laboratory studies and in natural waters receiving wastewater are reviewed. Laboratory studies were undertaken to learn the nature and stoichiometry of the reactions, particularly the long-term oxidation, of the inorganic nitrogen constituents of a biological secondary wastewater treatment plant effluent in the receiving water. The progressive oxygen demand of an effluent, diluted with water from the stream to which it is discharged, incubated at 20 deg C, was followed for periods of up to 40 days. In all cases the oxygen consumption curves showed a phase interpreted as the oxidation of inorganic nutrients. Inability to establish natural environmental conditions in the laboratory seriously hampers in vitro studies of the nitrification phenomenon. (Knapp-USGS)
W70-03034

TEMPERATURE AND TURBULENCE EFFECTS ON THE PARAMETER (DELTA) IN THE STOCHASTIC MODEL FOR BOD AND DO IN STREAMS,
Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center; Virginia Polytechnic Inst., Blacksburg. Dept. of Sanitary Engineering; and Virginia Polytechnic Inst., Blacksburg. Dept. of Statistics.
Joseph R. Bosley, John J. Cibulka, and Richard G. Krutchkoff.
Available from the Clearinghouse as PB-189 086, $3.00 in paper copy, $0.65 in microfiche. Virginia Polytechnic Institute Water Resources Research Center Bulletin 33, Nov 1969. 33 p, 10 fig, 3 tab, 11 ref. OWRR Proj No A-027-VA, FWPCA Grant No WP-01216-01.

Descriptors: *Dissolved oxygen, *Reaeration, *Biochemical oxygen demand, *Turbulence, *Water temperature, Water pollution effects, Streamflow, Oxygen sag, Waste assimilative capacity, Statistical models.
Identifiers: Dissolved oxygen calculations.

A literature review and laboratory study were made of the effects of water temperature and turbulence on dissolved oxygen and BOD in streams. Methods used to calculate the effects of pollution upon the assimilative capacity of a stream are reviewed. The equations available in the literature make possible calculations of BOD and dissolved oxygen concentrations if initial conditions and dynamic parameters are known. A series of simulated DO sag curves under varying conditions of temperature and turbulence were developed in the laboratory. These were accomplished by probe measurements of dissolved oxygen in a series of test solutions to which glucose feed solutions were added. The stream parameters were estimated and the parameter delta, the incremental DO change, was calculated under each test condition. A plot of temperature versus delta and turbulence versus delta demonstrated that the parameter was of a physical nature. This concept of delta allows an investigator to predict a range of dissolved oxygen values given a set of initial conditions. The probability of any actual DO value falling within this range may also be obtained, allowing intelligent pollution control decisions to be made based on the probability function. (Knapp-USGS)
W70-03066

EFFECTS OF THERMAL STRATIFICATION UPON OXYGEN RESOURCES - JOHN H. KERR RESERVOIR,
Federal Water Pollution Control Administration, Charlottesville, Va. Middle Atlantic Region.
Robert C. Horn, and Russel H. Wyer
Federal Water Pollution Control Administration Middle Atlantic Region, Technical Paper TS-1, June 1968. 15 p, 6 fig, 1 tab, 1 map.

Descriptors: *Water quality, *Dissolved oxygen, *Stratification, *Reservoirs, *Virginia, Thermal stratification, Epilimnion, Hypolimnion, Water pollution sources, Water quality act, Water quality control, Water resources development, Reservoir operation.
Identifiers: *Roanoke River (Va), John H. Kerr Reservoir (Va).

During the 1967 stratification period, a study was made of the oxygen resources of the John H. Kerr Reservoir and Roanoke River, Virginia. Vertical sections of dissolved oxygen and temperature were sampled at 14 stations in the reservoir throughout the summer. These parameters were monitored continuously in the tailrace and several times at 9 stations along the course of the river below the dam. Thermal stratification takes place in the reservoir between June and September; stratification was similar for all years. The thermocline is 20-40 ft deep and most clearly defined in July and August. Dissolved oxygen concentrations in the hypolimnion generally range from 0.0 mg/l to 2.5 mg/l throughout the reservoir in July, August, and the first weeks of September. Most of the water passing through the penstocks is drawn from the oxygen-deficient hypolimnion resulting in contravention of State Water Quality Standards immediately below the dam for approximately two months each summer. No significant relationship exists between magnitude of discharge and dissolved oxygen in the tailrace. (Knapp-USGS)
W70-03070

THE EFFECTS OF THERMAL POLLUTION ON RIVER ICE CONDITIONS: 2. A SIMPLIFIED METHOD OF CALCULATION,
Army Terrestrial Sciences Center, Hanover, N.H.
S. Lawrence Dingman, and Andrew Assur.
Cold Regions Research and Engineering Laboratory Research Report No 206, Part 2, Aug 1969. 10 p, 3 fig, 1 tab, 5 ref, 1 append. DA Task No 1T061102B52A02.

Descriptors: *Thermal pollution, *Ice, *Melting, *Heat balance, Heat transfer, Water temperature, Equations, Heated water, Path of pollutants.
Identifiers: Heat loss equations.

Equations are presented and explained for use in calculating heat loss rates, temperature profiles, and lengths of ice-free reaches caused in rivers by thermal pollution sources. The use of computers is not necessary to solve the equations, which are linear functions of the difference between water temperature and air temperature. Another simple procedure for calculating heat losses is based on air temperature, wind speed, solar radiation, and general atmospheric conditions. (Knapp-USGS)
W70-03089

5D. Waste Treatment Processes

OXIDATION PONDS REMOVE BACTERIA,
Department of Water Resources, Durham, N.C.
J. R. Malone, and T. L. Bailey.
WATER AND SEWAGE WORKS, Vol 116, No 4, p 136-140, Apr 1969. 2 fig, 3 tab, 9 ref.

Descriptors: *Oxidation lagoons, *Disinfection, *Tertiary treatment, Pilot plants, Coliforms.
Identifiers: *Bacterial removal, *Nutrient stripping enterococci, Durham, N.C.

This article reports the results of a pilot plant study. Tertiary oxidation ponds can be used to substitute for chlorination of plant effluents at a financial saving. Furthermore, benefits in reduction of BOD and turbidity and plant breakdown buffering capacity add to the reasons for preferring the ponds over chlorination. Short-lived radioisotopes in hospital and lab wastes are given time to decay before reaching the receiving stream. Algae removal from the pond effluent needs further study. (Ledbetter-Texas)
W70-03040

AERATED STABILIZATION BASIN TREATMENT OF WHITE WATER,
Quirk, Lawler and Matusky, New York.
Thomas P. Quirk.
Water Wastes Engr, Vol 6, No 7, p D.1-D.5, July 1969. 5 fig, 4 tab.

Descriptors: *Biological treatment, *Design data, *Industrial waste, Costs, Cost analysis, Biochemical oxygen demand
Identifiers: *Aerated lagoon, *Stabilization pond, Pilot plant studies, Boxboard wastes, Clarification, Suspended solids, Nutrient addition.

A study of a boxboard manufacturing waste and its biological treatment is described. The performance of an existing clarifier which removed 65 to 95% of the suspended solids (600 to 1800 mg/l) and reduced the BOD by 35 to 40% was studied. A pilot scale aerated stabilization basin was used to study the efficacy of this type of treatment. The addition of nitrogen and phosphorus permit a 75% BOD removal with a short-term basin and a clarifier or a long-term basin without a clarifier. The minimum cost alternative was estimated at about 4.5 cents per pound of BOD removed. (Ledbetter-Texas)
W70-03041

COMBINED TREATMENT OF TANNERY AND MUNICIPAL WASTES,
Syracuse Univ., N.Y. Dept. of Civil Engineering; and Vrooman (Morrell), Gloversville, N.Y.
Nelson L. Nemerow, and Richard Armstrong.
Water Wastes Engr, Vol 6, No 7, p D.6-D.9, July 1969. 5 fig, 3 tab.

Descriptors: *Industrial wastes, *Municipal wastes, Design data, New York, Biochemical oxygen demand, Sludge digestion, Activated sludge.
Identifiers: *Combined wastes, *Tannery wastes, Laboratory models, Stream survey, Conventional treatment.

This report is the result of a consulting study that was made on the wastes and waste treatment at Gloversville and Johnstown, New York. A stream survey was made to determine the BOD removals required to keep the steam DO about 2 mg/1. This survey indicated that 65 to 97% removal would be necessary. Laboratory studies were run to find whether the mixture of the tannery waste and the municipal waste was amenable to treatment by conventional activated sludge process. The recommended treatment scheme varied from the conventional in that a two-stage secondary treatment (high rate roughing filters followed by activated sludge treatment with mechanical aeration) was included. (Ledbetter-Texas)
W70-03042

POLLUTION ABATEMENT OF A DISTILLERY WASTE,
Kentucky Univ., Lexington; Watkins (G. Reynolds), Lexington, Ky.; and Aer-O-Flo Corp., Florence, Ky.
C. E. Burkhead, C. A. Lessig, and T. R. Richardson.
Water Wastes Engr, Vol 6, No 5, p C.20-C.22, May 1969. 2 fig, 4 tab, 12 ref.

Descriptors: *Industrial wastes, *Activated sludge, *Design data, Costs, Construction costs, Heat transfer, Biochemical oxygen demand, Biological treatment.
Identifiers: *Pilot studies, *Distillery wastes, *Oxygen transfer, Suspended solids, Settleable solids, Brewery wastes.

Operating data for a pilot plant waste treating operation is described. A 5000-gal holding tank (for cooling wastes) and a 10,000-gal extended

aeration activated sludge tank (including a 1670-gal settling unit) were used to treat loadings of 4250 to 10,500 gal per day of wastes. BOD removals ranged from 77 to 97% (avg of 91.5%) at loadings of 3 to 27 lb/day-1000 cuft (avg of 18 lb). The volume of the holding tank is included in the loading calculations. The effluent quality must be of the order of 20 to 30 mg/l BOD. Aerated lagoons give an economical adaptation of the activated sludge process. In addition to BOD removal, the large surface area enhances heat removal from the hot wastes. The aerated lagoon design was for a pond 3 feet deep with 5 days retention. The pond may be operated at a depth of 5 feet if necessary to get the desired effluent quality. The cost of the pond construction is estimated at $71,000. (Ledbetter-Texas)
W70-03043

ENGINE PLANTS RECOVER AND REUSE OIL FROM WASTEWATER,
Ford Motor Co., Cleveland, Ohio. Cleveland Engine Plants.
S. J. Halasz, C. C. Keil, and G. J. Schutt.
Water Wastes Engr, Vol 6, No 5, p C.24-C.28, May 1969. 2 fig.

Descriptors: *Skimming.
Identifiers: *De-emulsification, *Oil removal, Settling lagoon, Cutting oils, Soluble oils, Reclaimed oil, Water recycle.

A treatment system that reclaims oil from wastewater at the engine plant of Ford Motor Co. in Cleveland is described. Lubricating oil, honing oil, and hydraulic oil are insoluble and will float to the surface for skimming along with varying amounts of the soluble cutting oils. Most of the soluble oil is in an inverted emulsion which is broken by heating with de-mulsifying agents. The mixture is put into a settling lagoon where it separates into three fractions--oil, oil-water mixture, and water. The oils are removed, treated, and reclaimed. The water is returned to the surge tank for reuse. This treatment scheme has resulted in a better oil and a savings in cost. (Ledbetter-Texas)
W70-03044

REMOVAL OF ORGANIC COLLOIDS BY MICROFLOTATION,
Clarkson Coll. of Technology, Potsdam, N.Y.; and Ohio State Univ., Columbus. Water Resources Center.
E. A. Cassell, A. J. Rubin, H. B. LaFever, and E. Matijevic.
Water Wastes Engr, Vol 6, No 5, p C.7-C.10, May 1969. 9 fig, 2 tab, 19 ref.

Descriptors: *Foam separation, *Model studies, E. Coli, Electrolytes, Tertiary treatment.
Identifiers: *Microflotation, Color removal, Turbidity removal, Bacteria removal.

The application of microflotation or foam separation to the treatment of wastewaters seems practical in many water renovation applications at the present. Microflotation can replace coagulation-sedimentation and be followed by the new high-rate filters. This unit would be compact because of the rapid removal of the color-and turbidity-causing particles. It is also a rapid and efficient method of removing bacteria. Research is needed to better understand the effects of various types of dispersions, electrolytes and/or polyelectrolytes. Test data for the removal of the colloidal materials by foam separation is presented. (Ledbetter-Texas)
W70-03045

MODERN AERATION TECHNIQUES,
Fuller Co., Catasauqua, Pa. Infilco Products Group.
Charles E. Tharp.
Water Wastes Engr, Vol 6, No 6, p 31-33, June 1969. 3 fig, 1 tab, 6 ref.

Descriptors: *Aeration, *Biological treatment, *Activated sludge, Design data, Biochemical, Oxygen demand.
Identifiers: *Aeration equipment, *Oxygenation, *Porous diffusers, Turbine aerators, Brush aerators, Pump-type horsepower, Power consumption.

A description of the basic mechanisms for oxygenation of wastewaters is described. The power requirements for a radial flow surface aerator, a submerged turbine aerator, and porous diffusers are 20, 40, and 50 HP, respectively, for 1 mgd flow with a BOD-5 of 250 mg/l. The article gives design data and practices for aeration during biological wastewater treatment. (Ledbetter-Texas)
W70-03046

NEW APPROACH TO AEROBIC TREATMENT OF WASTES,
Allis-Chalmers Mfg. Co., Milwaukee, Wis. Water Pollution Research.
Fred M. Welch.
Water Wastes Engr, Vol 6, No 7, p D.12-D.15, July 1969. 5 fig, 2 ref.

Descriptors: *Aerobic treatment, *Biological treatment, Dissolved oxygen, Temperature.
Identifiers: *Aerobic digestion, Process development, Hydraulic loading, Chemical oxygen demand, Suspended solids, Revolution rate, Rotating biological contractor.

Tests run on a Rotating Biological Contractor (RBC) using a synthetic sewage developed at the Univ of Wisconsin are described. The concentration of influent was varied from 500 to 4000 mg/l COD and the hydraulic flow rate from 200 to 800 gph. The RBC is a series of rotating disks that are partially submerged and are rotated in the waste. It was concluded that the many process variables make the RBC suitable for treating a wide range of biodegradable wastes. The RBC retains a large fixed biological film, but, unlike the trickling filter, it effectively utilizes the entire film surface area and is not susceptible to clogging. Pilot plant work is being conducted in connection with an industrial application. (Ledbetter-Texas)
W70-03047

STORMWATER DISINFECTION AT NEW ORLEANS,
Pavia-Byrne Engineering Corp., New Orleans, La.; and New Orleans Sewage and Water Board, La.
Edgar H. Pavia, and Crawford J. Powell.
J Water Pollut Contr Federation, Vol 41, No 4, p 591-606, Apr 1969. 10 fig, 1 ref.

Descriptors: *Chlorination, *Storm runoff, *Disinfection, Chlorine, Design, Pumping plants, Coliforms.
Identifiers: *Hypochlorites, *New Orleans, *Lake Ponchartrain, Open channels.

A progress report is given on a project to disinfect storm waters in New Orleans. The project aims to show the feasibility of reducing the coliform count by adding chlorine or hypochlorite at pumping stations and letting disinfection take place in open channels of populated areas. The study will encompass the effect of such treated storm waters when they are discharged into body contact recreational areas. The Lake Ponchartrain area of New Orleans is the site of the test to begin in early 1969. (Ledbetter-Texas)
W70-03048

LABORATORY STUDIES OF TANNERY WASTE TREATMENT,
Washington Univ., St. Louis, Mo.; Vanderbilt Univ., Nashville, Tenn.; and Tennessee State Div. of Streams Pollution Control, Nashville.
H. D. Tomlinson, E. L. Thackston, P. A. Krenkel, and V. W. McCoy.
J Water Pollut Contr Federation, Vol 41, No 4, p 660-678, Apr 1969. 13 fig, 10 tab, 30 ref.

Descriptors: *Industrial wastes, *Activated sludge, *Chemical precipitation, Neutralization, Lime, Pilot plants.
Identifiers: *Tannery wastes, *Chrome tanning, *Alum tanning, *Vegetable tanning, Leather.

The laboratory development of treatment processes for chrome, alum, and vegetable tanning wastes is described. They give the chemical and other characteristics for the various waste streams at the tannery, then present their recommendations for treatment. The recommended practice is separate pretreatment of the spent vegetable tanning liquor (p H adjust and alum coagulation), chrome tanning liquor (pp t with lime), and dye wastes (color removal) followed by a combined biological treatment (completely mixed activated sludge). (Ledbetter-Texas)
W70-03049

CENTRIFUGES CONCENTRATE AND DE-WATER WASTE SYSTEM SOLIDS,
Pennsalt Chemicals Corp., Warminster, Pa. Sharples-Equipment Div.
Frederick W. Keith, Jr.
Water and Sewage Works (Industrial Wastes Supplement) Vol 116, No 3, p IW/10-IW/18, Mar 1969. 11 fig, 1 tab.

Descriptors: *Centrifugation, *Dewatering, *Sludge treatment, Coagulation, Sedimentation, Pulp and paper industry, Municipal wastes, Industrial wastes efficiencies.
Identifiers: *Scroll centrifuge, *Disc centrifuge, Petroleum refinery, Electrochemical machining.

Centrifuges are used on relatively small volume waste streams, usually after gravity concentration. Scroll centrifuges and disc centrifuges are described with applications in paper and pulp industry, petroleum refinery, municipal waste treatment, and electrochemical machining. Efficiency curves are shown for these applications. The authors conclude that the use of centrifuges in wastewater treatment will continue to increase. (Ledbetter-Texas)
W70-03050

WASTEWATER TREATMENT PLANT OPERATIONAL PROBLEMS AT HAIFA, ISRAEL,
Haifa Municipality Sewage Treatment Plant (Israel).
Michael Lubzens.
J Water Pollut Contr Federation, Vol 41, No 3, Part 1, p 413-417, Mar 1969. 2 fig, 1 ref.

Descriptors: *Scum, *Operation and maintenance, *Water reuse, *Detergents, *Ammonia, Irrigation, Salinity, Cotton, Cooling towers, Digestion tanks, Mixing.
Identifiers: *Biofiltration, *Reuse, *Suspended solids.

The Haifa, Israel, wastewater treatment plant treats 8.8 mgd of waste from 270,000 people. The plant is overloaded by 15 to 20 percent and is being doubled in size. The present treatment entails primary sedimentation, two-stage biofiltration, secondary sedimentation and chlorination. The effluent BOD is 35 (summer) to 75 (winter) mg/l after removals of 95% and 86%, respectively. The effluent contains (1) psychoda fly larvae, pupal, and discarded pupal skins because no secondary skimming is practical. (2) 1200 to 1400 mg/l of dissolved solids; (3) 60 mg/l of ammonia; and (4) 15 mg/l of detergents (as ABS). The salinity limits reuse of the effluent to cotton irrigation and the ammonia and detergents prevent its use in cooling towers. Scum on the digesters (up to 10 ft) is causing problems. The new design plans to use the existing plant more effectively and to lower effluent BOD, turbidity and suspended solids. (Ledbetter-Texas)
W70-03051

CANNERY WASTE TREATMENT BY SPRAY IRRIGATION-RUNOFF,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Cincinnati Water Research Lab.; and Campbell Soup Co., Napoleon, Ohio.
T. W. Bendixen, R. D. Hill, F. T. DuByne, and G. G. Robeck.
J Water Pollut Contr Federation, Vol 41, No 3, Part 1, p 385-391, Mar 1969. 2 fig, 9 tab, 4 ref.

Descriptors: *Canneries, *Industrial wastes, *Foods, *Tomatoes, Irrigation, Runoff, Soil treatment, Grasslands, Wastewater treatment, Ohio, Chemical oxygen demand.
Identifiers: *Cannery waste, *Spray irrigation, Food processing.

A spray irrigation-runoff system is used to treat the wastes from a tomato-processing plant. The facility employs 5 plots containing a total of 165 acres. The waste is sprayed intermittently, 6 hrs on and 6 hrs off, at the top of 5% grassy slopes and the runoff collected after runs of 100 to 200 ft. Tests show that 30 to 40% of waste runs off, with the treatment efficiencies as follows: COD, 95%; nitrogen, 93%; phosphates, 84% and suspended solids, 97%. Rainfall increases the runoff and decreases the efficiencies. (Ledbetter-Texas)
W70-03052

TREATMENT OF MIXED INDUSTRIAL WASTES AT BAYPORT'S INDUSTRIAL COMPLEX,
Friendswood Development Co., Houston, Tex.
George B. Meriwether.
J Water Pollut Contr Federation, Vol 41, No 3, Part 1, p 440-444, Mar 1969. 1 fig, 2 ref.

Descriptors: *Industrial wastes, *Activated sludge, Biological treatment, Incineration, Cost allocation, Costs, Classification, Waste water treatment.
Identifiers: *Central treatment facility, *Mixed wastes, Houston (Tex), Segregation of wastes.

A central waste treatment facility is described; it is serving 6 industries presently with 6 more industries under construction. The capacity is about 1 MGD now and can be expanded to 40 MGD. The wastes are sorted into 3 classes: a 'clean' stream, a 'biological' stream, and a non-acceptable stream. The first two categories can be treated biologically while the third requires incineration or deep-well injection. The plant charges $0.34 to $0.44 per 1000 gal with BOD up to 250 mg/l and $0.17 to $0.22 per lb of BOD for wastes with BOD greater than 250 mg/l. (Ledbetter-Texas)
W70-03053

ACTIVATED SLUDGE STUDIES AT DECATUR, ILLINOIS,
Decatur Sanitary District, Ill.
Charles E. Hughes, Jr., and Jeramiah F. Reynolds.
J Water Pollut Contr Federation, Vol 41, No 2, Part 1, p 184-198, Feb 1969. 22 fig, 1 tab.

Descriptors: *Activated sludge, *Aeration, *Dissolved oxygen, Efficiencies, Toxicity, Analytical techniques, Domestic wastes.
Identifiers: *Cross roll aeration, *Operating problems, Diffusers, Sparjers, Alpha coefficient, Beta coefficient, Decatur (Ill).

This article describes a study of the operating problems in an activated sludge plant. Toxicity studies showed that toxic materials were not the cause of the problems. Low dissolved oxygen was found to be at the root of the difficulties. The aeration was changed from spiral roll to cross roll and oxygen transfer increased 55 to 60%. The authors recommend standard methods of determination for alpha coefficient, K-sub-L A, and beta coefficient, the ratio of oxygen solubility in the waste to that in water. (Ledbetter-Texas)
W70-03054

OCCURRENCE OF ENTERIC VIRUSES IN WASTEWATER AFTER ACTIVATED SLUDGE TREATMENT,
Municipal Virological Lab., Goteborg (Sweden); and Goteborg Univ. (Sweden). Institutes of Mecical Microbiology.
Ebba Lund, C. E. Hedstrom, and N. Jantzen.
J Water Pollut Contr Federation, Vol 41, No 2, Part 1, p 169-174, Feb 1969. 2 fig, 10 ref.

Descriptors: *Viruses, *Effluents, *Chlorination, *Activated sludge, Isolation, Temperature, Sampling.
Identifiers: *Enteric viruses, *Viral concentrations, Etherization, Sweden.

The authors report the results of a virus survey on weekly samples for 18 months of an activated sludge effluent from a plant serving 40,000 population (Nasetverket). One sample produced no more than 3 types of viruses. The treatment process reduced the viral count by about 1.5 log units (31x) but was much less effective toward the end of the calendar year. They found no effect from in-plant chlorination. (Ledbetter-Texas)
W70-03055

TERTIARY TREATMENT AT METRO CHICAGO BY MEANS OF RAPID SAND FILTRATION AND MICROSTRAINERS,
Metropolitan Sanitary District of Greater Chicago, Ill.
Bart T. Lynam, Gregory Ettelt, and Timothy McAloon.
J Water Pollut Contr Federation, Vol 41, No 2, Part 1, p 247-279, Feb 1969. 36 fig, 9 tab, 7 ref.

Descriptors: *Tertiary treatment, *Cost comparisons, *Activated sludge, Sands, Coagulation, Design criteria, Sedimentation, Computer programs.
Identifiers: *Sand filters, *Microstrainers, Rapid sand filters, Chicago.

Results are reported on 5 months of investigation into tertiary treatment of Hanford Park (Chicago) effluent. A 2 mgd plant with rapid sand filters (traveling backwash) and microstrainer was operated under varying conditions. The sand filter was found to be more economical than the microstrainer for effect achieved, $0.024/1000 gal vs $0.028/1000 gal. Either method with pre-chlorination can meet 5 mg/l suspended solids and 4 mg/l BOD criteria of Illinois Sanitary Water Board. Coagulation with alum did not improve the results achieved. (Ledbetter-Texas)
W70-03056

USE OF AERATED LAGOONS AND PONDS IN REFINERY AND CHEMICAL WASTE TREATMENT,
Texas Univ., Austin. Center for Research in Water Resources; and Humble Oil and Refining Co., Baytown, Tex.
Earnest F. Gloyna, S. O. Brady, and H. Lyles.
J Water Pollut Contr Federation, Vol 41, No 3, Part 1, p 429-439, Mar 1969. 5 fig, 7 tab, 6 ref.

Descriptors: *Lagoons, *Aeration, *Industrial wastes, Stabilization, Ponds, Design criteria, Dissolved oxygen.
Identifiers: *Refinery, *Petrochemicals, Stabilization ponds, Aerated lagoons, Houston (Tex).

This paper describes the staged development of industrial wastewater treatment facility for a refinery and petrochemical complex. Emphasis is directed to the utilization of available land for three series-connected waste stabilization ponds, the implementation of this treatment system with an aerated lagoon and the compatibility of this plan with future collection and treatment requirements. The wastewater management plan includes various in-plan separators, and extraction units, an extensive oil collection and separator system, surface aerators, and 351 acres (142ha) of waste stabilization ponds. Provisions can be made to expand the facility if the waste loads continue to increase or additional waste streams are provided by the petrochemical complex. Allowable BOD loading is 50,000 lb/day (22,600 kg). Recommended volume to the first pond is 7.7 mgd (29,200 cu m/day). BOD removal is 72 percent, COD is 84 and 90 percent. (Ledbetter-Texas)
W70-03057

DIATOMITE FILTRATION IN A BOARD MILL,
Johns Manville Research and Engineering Center, Manville, N.J.
F. B. Hutto, Jr.
Water Wastes Eng (Industrial), Vol 6, No 3, p B.5-B.9, Mar 1969. 5 fig, 1 tab.

Descriptors: *Filtration, *Diatomaceous earth, Pilot plants, Cost analysis, Design data.
Identifiers: *Board mill, Closed recycle, Makeup water.

A closeup recycle of wastewater is described for a Fesco board (perlite, wood pulp, asphalt, and admix) plant in France. A diatomaceous earth filter (celite 545) with a capacity of 300 gpm was installed after pilot plant tests of various filter aids, including perlite. Rotary knives remove the cake from the drum. About 1 ton per week of the celite 545 must be replaced. River water for make up is brought into the system through the rotary precoat filter. Evaporation occurs at approximately 6000 gph, whereas the volume of the loop is only 12000 gal. The success of the closed cycle lay in: successful removal of solids, stabilization of solubles buildup, and return water reused. (Ledbetter-Texas)
W70-03058

OPERATING EXPERIENCE WITH HIGH-RATE FILTERS,
Gary Sheet and Tin Works, Ind.; and United States Steel Corp., Pittsburgh, Pa.
V. F. Frank, and James P. Gravenstreter.
J Water Pollut Contr Federation, Vol 41, No 2, Part 1, p 292-296, Feb 1969.

Descriptors: *Filtration, *Industrial wastes, *Steel, Iron oxides, Wastewater treatment.
Identifiers: *High-rate filters, *Scale, Gary (Ind), Suspended solids, Anthracite, Sand, Gravel.

High-rate gravity filters can remove the iron oxide scale and dust from steel processing water. Twelve filters 15 feet square by 23 feet deep were constructed of 1 foot square concrete blocks covered with 15 in. of gravel, 2 feet of sand, and 5 feet of anthracite. The process produced an effluent with not more than 15 mg/l suspended solids at filtration rates from 16 to 32 gpm/sq ft. The 160,000 gpm ultimate demand can be treated. (Ledbetter-Texas)
W70-03059

ECONOMIC EVALUATION: ALTERNATIVES FOR INDUSTRIAL TREATMENT,
Wichita State Univ., Kans.
Kathleen Q. Camin.
Water and Sewage Works (Industrial Wastes Supplement), Vol 116, No 7, p Iw/8-Iw/13, July 1969. 1 fig, 4 tab.

Descriptors: *Cost analysis, *Cost comparisons, Discount rate, Annual costs, Municipal wastes, Industrial wastes, Interest.
Identifiers: *Primary costs, *Secondary costs, Present value, Time horizon, Revenue bonds.

The alternatives for industrial disposition of wastes are the following: (1) complete treatment by municipality, (2) complete treatment by the industry, (3) partial treatment by industry followed by municipal treatment, or (4) alteration of process to produce less waste and/or lower strength. A hypothetical meat packing plant is used as an example to illustrate the costs of the various alternatives in primary costs (repayment of principal, interest, and operation and maintenance) and secondary costs (penalties, sale of products, and public

relations). The annual costs are computed for trickling filter, anaerobic contact, and anaerobic-aerobic lagoons. The present values of the alternatives show the proper selection of treatment for different interest rates. (Ledbetter-Texas)
W70-03060

SPRAY IRRIGATION OF FERMENTATION WASTES,
Commercial Solvents Corp., Terre Haute, Ind.
Richard A. Woodley.
Water Wastes Eng (Industrial) Vol 6, No 3, p B.14-B.20, Mar 1969. 2 fig, 2 tab, 16 ref.

Descriptors: *Sprinkler irrigation, *Fermentation, Industrial wastes, Maintenance, Vegetation.
Identifiers: *Fermentation wastes, Terre Haute (Ind).

Spray irrigation is used to treat low-volume, high BOD, industrial fermentation wastes at the Commercial Solvents Corp. plant in Terre Haute, Indiana. Seven other treatment methods for various wastewater streams are employed at the same plant. The monthly average applications over the last 3 years ranged from 43,000 gpd to 85,000 gpd with BOD from 300 mg/l to 65,000 mg/l. The treatment has been applied on 180 of the available 372 acres of land. Monitoring is carried out on the wastes and the groundwater under the area. The vegetation is left on the land during spraying. Some corrosion of the aluminum pipe has been noted. Winter operations have not produced problems. (Ledbetter-Texas)
W70-03061

ARMCO'S 100,000- gpm MILL-SCALE WASTEWATER TREATMENT PLANT,
Armco Steel Corp., Middletown, Ohio. Air and Water Pollution Control.
John E. Barker, Richard W. Getter, and Grant A. Pettit.
J Water Pollut Contr Federation, Vol 41, No 2, Part 1, p 301-307, Feb 1969. 7 fig.

Descriptors: *Industrial wastes, *Steel, *Wastewater treatment, Design criteria, Coagulation, Sedimentation, Lime, Vacuum drying, Sludge treatment.
Identifiers: *Mill-scale wastes, *Ferric sulfate, Sludge dewatering polyelectrolytes, Armco, Middletown (Ohio).

The 100,000 gpm (144 MGD) mill-scale, wastewater treatment plant of Armco at Middletown, Ohio, is probably the largest plant of its type in the USA. The plant treats an 86 in. hot strip mill waste in two steps-primary sedimentation and coagulation. The primary treatment unit has 5 sub-systems and the secondary 3. Lime is used to adjust the pH to the range of 8.2 to 8.5 and ferric sulfate used as a coagulant. Four belt type vacuum filters, each with 800 sq ft of filterarea, dewater the sludge which is loaded into gondola cars for disposal. (Ledbetter-Texas)
W70-03062

CONCENTRATION OF SEAWATER BY ELECTRODIALYSIS,
Japan Monopoly Corp.
For primary bibliographic entry see Field 03A.
W70-03079

INTRASOIL UTILIZATION OF SEWAGE WATER SEDIMENTS (RUSSIAN),
Institute of Medical Parasitology and Tropical Medicine (USSR).
For primary bibliographic entry see Field 03C.
W70-03125

DESIGN PARAMETERS FOR BOD, SOLIDS AND NUTRIENT REMOVAL BY FOAM FRACTIONATION,
FMC Corp., Santa Clara, Calif. FMC Machinery/Systems Group.
M. Floyd Hobbs.
FMC Corporation, Central Engineering Laboratories, Technical Report R-2737, Dec 1968. 54 p, 14 fig, 12 tab, 12 ref. FWPCA Grant WRRD-30-01.

Descriptors: *Foam fractionation, *Ion exchange, *Surfactants, *Waste water treatment, *Water pollution control, Vegetable crops, Treatment facilities, Pilot plants, Laboratory tests, Ammonium compounds.
Identifiers: *San Jose, *Santa Clara, *San Francisco Bay, FMC Corporation.

Process development studies and laboratory investigations are described for removing nutrients (especially phosphate) and suspended solids from secondary wastewater treatment effluents by a foam fractionation process using a liquid ion exchange surfactant. Bench studies were conducted on synthetic waste waters and secondary effluent from the San Jose-Santa Clara Water Pollution Control Plant. Findings indicate that removal of orthophosphate, nitrate, nitrite, and sulfate ions is possible using a surface active quaternary ammonium chloride, which can be regenerated to the chloride form. During the vegetable canning season, an objectionably high concentrations of sludge particles and oxygen demanding materials are discharged from the local treatment plant into the San Francisco Bay. The form fractionation process recommended should provide substantial reductions of sludge particles, BOD and nutrients to help meet Bay Area regulations. A pilot plant for processing 10 gpm of effluent from the treatment plant was designed. The portable plant is estimated to cost $50,000. The report includes preliminary findings, additional bench-scale studies needed to quantitate previous results on a continuous-flow basis, and an economic evaluation of design parameters. (Poertner-Chicago)
W70-03137

RECLAMATION OF WASTEWATER.
Los Angeles City Dept. of Water and Power, Calif.

Los Angeles, Dept of Water and Power, City of Los Angeles, Oct 1968. 101 p, 30 fig, 11 tab, 55 ref, 8 append.

Descriptors: *Reclaimed water, *Water reuse, *Groundwater recharge, *Groundwater barriers, *Irrigation, Water spreading, Injection, Cooling towers, Water shortage, Recharge.
Identifiers: *Los Angeles, Process water.

This investigation was made to determine what portion, if any, of Los Angeles wastewater can be reclaimed for beneficial uses. The study was divided into three major categories: (1) magnitude of wastewater flows throughout the Los Angeles sewerage system and quality determinations; (2) potential situations for wastewater reuse; and (3) costs. Conclusions were that Los Angeles wastewater can beneficially be used for the following six projects: (1) groundwater recharge by surface spreading of treatment plant effluent at the Headworks, Tujunga and Pacoima spreading grounds; (2) injection of effluent from the Hyperion Treatment Plant into the ground to prevent sea water intrusion (West Coast Basin Barrier Project); (3) supply reclaimed water to Standard Oil's El Segundo Plant for cooling tower and process water; (4) irrigation of golf courses and parks using secondary treatment effluents in the Sepulveda Flood Control Basin; (5) irrigation in Griffith Park; and (6) irrigation of proposed parks in the Santa Monica Mountains with secondary effluent. The report included a recommendation that the City departments of Water and Power and Public works coordinate their efforts to develop and operate these projects. The report concludes that all of Southern California needs new water supplies and recommends wastewater reclamation as economically sound and politically expedient. (Poertner-Chicago)
W70-03141

A STUDY OF THE TECHNICAL AND ECONOMIC FEASIBILITY OF USING SEWAGE EFFLUENT FOR IRRIGATION IN LINCOLN PARISH, LOUISIANA,
Louisiana Polytechnic Inst., Ruston. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 03C.
W70-03159

PRELIMINARY DESIGN OF WASTE TREATMENT SYSTEMS,
Water Resources Engineers, Inc., Walnut Creek, Calif.
D. E. Evenson, G. T. Orlob, and J. R. Monser.
Ind Water Eng, Vol 16, No 1, p 16-21, Feb 1969. 6 p, 9 fig, 2 tab, 6 ref.

Descriptors: *Dynamic programming, *Waste water treatment, *Biochemical oxygen demand, *Dissolved oxygen, *Ponds, Construction costs, Maintenance costs, Interest rate, Capital, Design, Canneries, Seasonal.
Identifiers: Sensitivity analysis.

Dynamic programming techniques were used to find the best waste treatment system for removing biochemical oxygen demand (BOD) and treating solids at the minimum annual cost. A cannery for processing peaches and tomatoes was chosen for demonstrating the usefulness of dynamic programming in preliminary design. Results indicated that the least costly treatment processes for nearly all levels of BOD removal involved some system of ponds. Senstivity analyses were made to determine the influence of such parameters as interest rate, capital recovery period and land cost on both the cost and choice of the best treatment process. For the cannery waste studied, the minimum cost was found to be most sensitive to the length of the canning season, least sensitive to interest rate. In-plant treatment was opted over municipal treatment when BOD removal requirement was below 85%. (Thiuri-Cornell)
W70-03164

TIME CAPACITY EXPANSION OF WASTE TREATMENT SYSTEMS,
Pennsylvania State Univ., University Park; and Stanford Univ., Calif.
Thomas M. Rachford, Russell F. Scarato, and George Tchobanoglous.
J Sanit Eng Div, ASCE, Vol 95, No SA6, p 1063-1077, Dec 1969. 15 p, 4 fig, 4 tab, 15 ref, 1 append.

Descriptors: *Waste treatment, *Economics of scale, *Mathematical models, *Optimization, *Timing, Interest rate, Water demand, Capital cost, Investment, Decision making.
Identifiers: *Time capacity expansion.

A minimum-cost method was developed for quantifying the opposing cost factors of economies-of-scale and the time cost of money as they jointly affect optimal capital investment decisions for the expansion of wastewater treatment systems. For a linear demand growth rate, optimal facility expansion, with regard to both timing and capacity requirements, was determined using a mathematical model. The economic implications of different expansion policies were graphed for various interest rates and scales cost affects, using cost data mathematically formulated as a function of system capacity. The model was used to demonstrate that the optimal timing of facility expansion was a function of the time and cost of money and the economy-of-scale characteristics of that facility and was independent of the absolute capacity of the facility. Further additional economies inherent in individually expanding separable components of wastewater treatment system were quantified by the model. (Thiuri-Cornell)
W70-03167

PRELIMINARY SELECTION OF WASTE TREATMENT SYSTEMS,
Water Resources Engineers, Inc., Walnut Creek, Calif.
D. E. Evenson, G. T. Orlob, and J. R. Monser.

J Water Pollut Contr Federation, Vol 41, No 11, Part 1, p 1845-1858, Nov 1969. 14 p, 9 fig, 1 tab, 6 ref.

Descriptors: *Dynamic programming, *Waste water treatment, *Biochemical oxygen demand, *Dissolved oxygen, *Ponds, *Canneries, Construction costs, Seasonal, Maintenance costs, Interest rate, Capital design.
Identifiers: Sensitivity analysis.

Dynamic programming techniques were utilized to find the best waste treatment system for removing a specified amount of biochemical oxygen demand (BOD) at the least annual expenditures for construction maintenance and operation. This technique was applied to wastes typical of a cannery processing tomatoes and peaches. Results of this application indicated that for nearly all removal levels the least expensive treatment process was some system of ponds. Sensitivity analysis were made to determine the influence of such parameters as interest rate, capital recovery period and land cost on both the cost and choice of the best treatment process. For the cannery wastes studied, minimum cost was found to be most sensitive to the length of the canning season and least sensitive to interest rate. In-plant treatment was opted over municipal treatment when BOD removal requirement was below 85%. It was concluded that dynamic techniques outlined could be applied to the preliminary design of waste treatment system. (Thiuri-Cornell)
W70-03169

USE OF SYSTEMS ANALYSIS METHODS IN DETERMINING NEEDS AND IMPLEMENTING PROGRAMS FOR WASTE TREATMENT FACILITIES.
Federal Water Pollution control Administration, Washington, D.C.

In Examination into the Effectiveness of the Construction Grant Program for Abating, Controlling, and Preventing Water Pollution, Comptroller General of the United States, Report B 166506, Chap 6, p 80-97, Nov 1969. 18 p, 1 fig, 1 tab.

Descriptors: *Water quality control, *Systems analysis, *Pollution abatement, *Planning, *Waste assimilative capacity, Decision making, Water utilization, Waste treatment.
Identifiers: Merrimack River.

The use of systems analysis methods in determining needs and implementing programs for waste water facilities by the Federal Water Pollution Control Administration was discussed. The application of systems analysis to water quality control by Camp, Dresser and McKee particulary on the Merrimack River was presented. It was concluded that through the systems analysis approach to planning and implementing water pollution programs; (a) a least-cost construction plan to achieve water quality standards can be developed that considered the assimilative capacity of waterways, (b) more costly, but perhaps more desirable, alternative schedules could be developed, and (c) decision-makers will be provided with more meaningful data so as to enable them to determine the level of treatment required to achieve established objective and the costs of providing various levels of water uses. (Thiuri-Cornell)
W70-03176

5E. Ultimate Disposal of Wastes

ATTENUATION OF SELECTED NITROGEN FORMS BY SORPTION FROM AQUEOUS SOLUTION ONTO NATURAL SOILS,
Michigan State Univ., East Lansing. Coll. of Engineering
For primary bibliographic entry see Field 05B.
W70-02843

A STUDY OF DRAINAGE CONDITIONS ON A HILLSIDE RECEIVING SEWAGE PLANT WASTE WATER EFFLUENT AT WEEKLY INTERVALS,
Pennsylvania State Univ., University Park. Dept. of Agronomy.
Joel Claude Myers.
MS Thesis in Agronomy, Pennsylvania State Univ Graduate School, Sept 1967. 102 p, 27 fig, 29 tab, 31 ref, append. OWRR Project No B-001-PA.

Descriptors: *Waste water disposal, *Sewage effluents, *Irrigation, *Hydrogeology, Infiltration, Runoff, Saturated soils, Soil-water-plant relationships, Piezometry, Drainage, Demonstration watersheds, Observation wells, Irrigation water.
Identifiers: Sewage effluent irrigation.

The effects of sewage disposal by irrigation on soil and drainage conditions of a hillside were investigated by applying 2 inches of chlorinated sewage effluent per week for 2 years. The hillside slope consisted of a heterogeneous complex of Hagerstown-Hublersburg series. Ranges of sand, silt, and clay for example, were as follows: Sand (8-47%), silt (12-49%) and clay (21-72%). These and other soil determinations generally indicated great variability in the soil properties, including soil permeability both along the sloping area and within each site. Extent of perched water tables, which are upheld by layers of very low permeability, was determined at the 7 research sites. Generally the water-table surface was within 4 ft of the soil surface, except in dry summer periods where evapotranspiration was at a maximum. In winter, frost, soil and air temperatures, ice and snow caused variable effects on infiltration. Water storage and transmission were greatly reduced because of the perched water tables near the land surface. (Knapp-USGS)
W70-02893

5F. Water Treatment and Quality Alteration

IRON AND MANGANESE REMOVAL,
Manitoba Water Supply Board.
Jim Adams.
Water and Sewage Works, Vol 116, No 7, p 259, July 1969. 1 p, 1 ref.

Descriptors: *Water treatment, *Iron, *Manganese, Chemical precipitation, Filtration, Filters, Water management (Applied), Oxygenation, Oxidation.
Identifiers: Greensand filters, *Manganese removal.

Methods for removing iron and manganese from water are briefly described. Lime soda treatment is usually effective in removing manganese. On a laboratory scale, the Manitoba Water Supply Board has tried simple aeration to assist in the precipitation of iron and manganese followed by the injection of a 1.0% potassium permanganate solution into the stream. This is then followed by passing the water through a pressure filter containing a manganese greensand bed. The greensand filter will require backwashing possibly every two days, and, in addition, should be backwashed with air one each week. (Knapp-USGS)
W70-02869

PURE DRINKING WATER: REGULATION OF MINIMUM STANDARDS AND OF METHODS FOR OBTAINING PURE DRINKING WATER.

Wis Stat Ann secs 162.01-162.06 (1957), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Water quality control, *Potable water, *Water pollution, Standards, Regulation, Consumptive use, Groundwater, Water sources, Water supply, Public health, Construction, Wells, Well permits, Well regulations, Drilling, Water pumping, Water analysis, Investigations, Sanitary engineering, Water purification, Permits, Administrative agencies, Legal aspects, Legislation, Water pollution control.
Identifiers: Penalties (Civil).

The Department of Resource Development shall prescribe, publish, and enforce minimum standards and rules and regulations for obtaining pure drinking water. The Department is required to establish safeguards against the hazards of impure water supplies, including minimum standards for construction of well pits. The Department has general control of all methods of obtaining groundwater and of the construction of wells. The Department of Resource Development may exercise such powers as are necessary to enforce these provisions. It may: employ needed personnel, conduct investigations and experiments concerning the cause of groundwater pollution, make inspections, and require persons responsible for water supply to determine the purity of that water. All those engaged in well drilling and pump installing shall register with the Department and pay permit fees. Competent sanitary engineers and superintendents of waterworks systems are exempt from registration. Penalties for registration violations are provided. (Duss-Florida)
W70-02923

ECONOMICS OF SPLIT-TREATMENT WATER SOFTENING,
Department of Water, Dayton, Ohio.
Bruce S. Shuey.
American Water Works Association Journal Vol 58, No 1, p 107-112, Jan 1966.

Descriptors: *Economics, *Water softening, *Costs, Water treatment, Alkalinity, Benefits, Economic efficiency, Water quality.
Identifiers: *Split-treatment, *Single-stage softening, *Chemical costs, Soda ash, Carbon dioxide, Dayton (Ohio).

Split-treatment lime-soda water softening can be used under certian restricted conditions. The costs of this process, as opposed to single-stage softening, are compared and the former are found to be more economical. The three reasons for this are discussed and it was found that when a finished water with the minimum total alkalinity is produced and an average of 54 mgd is treated the annual savings amounted to more than $80,000. Modification in the method, resulting in a finished water which has aggressive characteristics, can still be accomplished with an annual saving of $55,000 at the same treatment rate. (Murphy-Rutgers)
W70-02989

THE TECHNOLOGY OF PURE WATER.

Presented at 7th Annual Liberty Bell Corrosion Course, Sept 16-18, 1969. Industrial Water Engineering, Vol 6, No 11, p 16-29, Nov 1969. 14 p, 13 fig, 3 tab.

Descriptors: *Water purification, *Demineralization, *Industrial water, *Water analysis, Quality control, Distillation, Filtration, Ion exchange, Water treatment, Pre-treatment (Water).
Identifiers: Deionization, Industrial ultrapure water.

Papers on quality requirements, preparation, and testing of ultrapure industrial water, presented at the 7th Annual Liberty Bell Corrosion Course sponsored by the National Association of Corrosion Engineers, 1969, are summarized. The main classes of contaminants to be removed and analyzed are particulate matter, ions, and organic material. Tests must be performed on flowing water in the system's output, because storage for any time will alter water quality. The classic pure water system consists of the following steps: (1) coagulation (with or without lime softening depending on the raw water available) and superchlorination; (2) granular bed filtration (sand); (3) activated carbon absorption and dechlorination; (4) ion exchange demineralization; (5) mixed-bed polishers includ-

ing final polishing demineralizers (usually the non-regenerable type); (6) roughing final filters or pre-filters (1-20 micron pore size); and (7) final polishing filters (0.3 - 0.8 micron pores). Conductance is undoubtedly the most commonly used measure of water quality. Even small laboratory units containing only 0.1 cu ft of resin for deionization are routinely equipped with some sort of conductance meter for monitoring water quality. Conductance meters capable of measuring down to the 0.01 - 1.0 micromho range are fairly inexpensive when compared to the cost of the average analytical instrument. Continuous measurement, accuracy, reproductibility, and ability to measure in the desired range all make conductance a common choice for monitoring water quality. (Knapp-USGS)
W70-03078

5G. Water Quality Control

COMBATTING WATER POLLUTION FROM LARGE OIL SPILLS,
George E. Ferguson.
AWWA J, Vol 61, No 12, p 678-680, Dec 1969. 3 p, 13 ref.

Descriptors: *Water pollution sources, *Oily water, *Legislation, *Water works, Oil, Oil industry, Oil wastes, Water pollution treatment, Administrative agencies, Fouling, Taste, Odor, Ships, Pipelines, Water supply, Public utilities, Water consumption, Water distribution, Streams, Lakes, Federal government, State governments, Local governments, Project planning.
Identifiers: *Water Pollution Control Act, *Oil spills.

The problem of water supplies polluted by oil spills was studied by Committee 2500R of the American Water Works Association. The Committee report revealed extreme incidents of oil spills and considered measures currently underway to protect water supplies. Polluting oil most frequently results from faulty petroleum pipelines. The federal government now requires pipeline companies to report every such major accident. These reports indicate the causes of the problem and assess the damage. As a result of this analysis, government emergency teams are being established to deal with major spills into navigable waters. Federal, state, and local governments will participate in this program which is designed to warn water utilities of spills and prevent oil from reaching the raw water intakes. The Federal Water Pollution Control Act is being revised to deal more effectively with oil spills, especially those from offshore tankers. It also provides penalties for vessels discharging oil. The Committee report indicates that water utilities have handled the emergencies well and have prevented lengthy breakdowns of water production. The Committee further recommends the preparation of a manual for use by water utilities on how to deal with and prevent oil spill emergencies. (Dearing-Florida)
W70-02895

STATE ACTIVITIES,
Richard S. Nelle.
Am Water Works Ass'n J, Vol 53, No 6, p 857-861, July 1961, 5 p, 7 ref.

Descriptors: *Illinois, *Water pollution, *Water pollution control, *Pollution abatement, State governments, Local governments, Legislation, Water rights, Riparian rights, Natural use, Natural flow doctrine, Reasonable use, Artificial use, Riparian lands, Groundwater, Percolating water, Eminent domain, Public health, Domestic water, Industrial water, Recreation, Watershed management, Waste disposal, Planning, Inter-agency cooperation, Water quality control.

The common-law water rights doctrine has been interpreted in Illinois by the natural flow and reasonable use theories. Stream pollution control laws have adopted the reasonable use theory. In other considerations of water rights, the natural flow theory has prevailed in diversion questions whereas the reasonable use is more frequently applied in consumption problems. Because water pollution knows no political boundaries, development in this area must come from state governments. With an expanding industrial economy and a greater competition for water use, pollution control cannot be attained without control of use. Any use of water involves a change in water quality, and this quality needs to be managed with increased precision as the quantity of water diminishes. Although the control of pollution is administered at the state level, local governments must exercise the authority granted to them to plan, construct, and police water sources. Control of watershed pollution is a cooperative venture. Cooperation must exist between local and state governments and among state agencies. Specific interests on the local level and on the state level are discussed. (Schram-Florida)
W70-02896

DISCHARGING NOXIOUS MATTER INTO HIGHWAYS AND SURFACE WATERS.
Wis Stat Ann sec 146.13 (1957), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Water pollution, *Sewage, *Highways, Surface waters, Drainage water, Drains, Pipes, Septic tanks, Cesspools, Outlets, Sewers, Discharge, Ditches, Wells, Cities, Abatement, Legislation, Regulation, Control, Domestic wastes, Legal aspects, Administrative agencies.
Identifiers: *Penalties (Criminal), Pumpage, Noxious matter, Sanitary District Commission.

Discharge of noxious matter into public highways through drains, pipes, sewers, or other outlets is prohibited. Local boards of health, town sanitary commissions, or county boards of health may order the offender to remove the discharged matter within ten days, and if such condition continues or recurs, cause its removal themselves. The cost shall be charged to the offender either by direct charges or by a municipal tax lien on the offender's lands. Recovery of such costs from railroad lands and other lands not taxed in the usual manner shall be effected through the state treasury. Persons maintaining such nuisances are subject to fine and imprisonment. No person shall discharge in any manner untreated domestic sewage into surface waters nor shall he discharge effluents or pumpage from septic tanks, dry wells, or cesspools into surface waters. Persons committing such offenses are subject to fine and imprisonment. (Duss-Florida)
W70-02912

GENERAL MUNICIPALITY LAW DEALING WITH SEWERAGE SYSTEMS.

Wis Stat Ann secs 66.076-66.078 (1965).

Descriptors: *Wisconsin, *Sewage disposal, *Sewage treatment, *Treatment facilities, Disposal, Environmental sanitation, Sewers, Sewage, Local governments, Legislation, Legal aspects, Waste water treatment, Water utilization, Water rates, Domestic wastes, Municipal wastes, Cities, ydrants, Water works, Regulation, Public utilities.

Any city may construct, acquire, or lease any plant or equipment for the collection, disposal and treatment of sewage. Purchase of these facilities is to be financed through taxation or bond sales. Such bonds are not a general indebtedness of the municipality, but are secured only by the sewage facilities. (Barnett-Florida)
W70-02917

OPEN PIT MINING.
Pa Stat Ann tit 52, secs 1396.1, 1396.4 (1966).

Descriptors: *Pennsylvania, *Mine drainage, *Coal mining, *Water pollution sources, Mine wastes, Mine acids, Acid mine water, Coal mine wastes, Water pollution, Soil erosion, Backfill, Excavation, Drainage engineering, Ditches, Dikes, Legislation, Administrative agencies, Administrative decisions, Terracing, Soil conservation, Water conservation, Legal aspects, Surface drainage, Permits, Percolating water, Subsurface waters.

As an exercise of the police power, Pennsylvania regulates open pit mining to conserve and improve affected lands, protect wildlife, decrease soil erosion, and to aid in the prevention of the pollution of rivers and streams. In applying for a permit to mine coal, a detailed proposal showing the time, distance, and manner for backfilling must be included. Such proposal shall also show the manner in which the mine operator plans to divert surface water from draining into the pit. Terracing may be approved so long as no depressions exist to hold water which may percolate through the spoil and produce acid drainage. The operator shall be responsible for the prevention of stream pollution by acid drainage or avoidable siltation. Failure to adequately maintain such ditches, dikes, pumps, and drainage facilities as may be necessary to prevent water from accumulating in the pit, or to prevent stream pollution, or siltation shall render the operator liable to the sanctions and penalties of this act. The Department of Mines and Mineral Industries shall be the exclusive investigating, examining, reporting, and enforcement agent of the Sanitary Water Board in relation to this act. (Schram-Florida)
W70-02929

THE USE OF PURE OXYGEN IN RIVER AND IMPOUNDMENT AERATION,
New Mexico State Univ., Las Cruces.
R. E. Speece.
Pap, 24th Purdue Ind Waste Conf, May 1969. 22 p, 11 fig, 11 ref.

Descriptors: *Aeration, *Dissolved oxygen, *Oxygen, *Limnology, *Reaeration, Impoundments, Costs, Water quality, Rivers, Lakes, Reservoirs, Injection, Oxygenation, Bubbles, Hypolimnion, Sanitary engineering, Water pollution.
Identifiers: Oxygen exchange.

The application of a generalized finite-element method to the static and dynamic analysis of plate and shell structures is presented. The displacement formulation of the finite-element method is used. A particular form of generalized variational principle is used, admitting completely arbitrary displacement functions for an element. The form of the matrix equations is presented and the method of solution and the problem of dependent algebraic equations are discussed. Numerical results for a variety of polynomial displacement forms and continuity requirements are discussed. Limitations of the method are pointed out. (USBR)
W70-02955

INSECTICIDES AND ALGAE: TOXICITY AND DEGRADATION,
Ontario Water Resources Commission, Toronto. Div. of Research.
A. E. Christie.
Ontario Water Resources Commission, Div of Research Publication No 27, 1968. 26 p, 9 tab, 31 ref.

Descriptors: *Algae, *Algal control, *Algicides, Analytical techniques, Aquatic algae, Aquatic environment, Aquatic microbiology, Balance of nature, Bioassay, Chlorophyta, Environmental effects, Inhibition, Limnology, Pesticides, Pesticide removal, Pesticide residues, Physiological ecology, Phytoplankton, Phytotoxicity, Plankton, Pollutant identification, Sewage, Sewage disposal, Sewage lagoons, Sewage treatment, Stabilization ponds, Water pollution control, Water pollution effects, DDT.
Identifiers: Chlorella pyrenoidosa, Pesticide degradation, Sevin, Malathion, Acetone, Ethanol.

Relationships between three insecticides (DDT, Sevin and Malathion) and algae with respect to toxicity and degradation were investigated using materials obtained from a nearby waste stabilization pond and axenic cultures of Chlorella pyrenoidosa at pH 6.0 and 9.0. DDT exhibited no toxic properties to either system at concentrations up to 100 milligram/liter and was broken down only to a limited extent by algae. Malathion exhibited no persistent inhibitory effect to algae and appeared to be metabolized fairly readily in comparison to the other two insecticides studied. Sevin at 100 milligram/liter was more toxic to the mixed pond algae than to Chlorella. The toxicity of Sevin to Chlorella was more pronounced at pH 6 than at pH 9 (30 and 15% inhibition, respectively). The effect of Sevin could be detected at 0.1 milligram/liter, but increasing concentrats had little increased effectiveness. (Fitzgerald-Wisconsin)
W70-02968

STUDIES ON CHEMICALS WITH SELECTIVE TOXICITY TO BLUE-GREEN ALGAE,
Wisconsin Univ., Madison. Water Chemistry Lab.
George P. Fitzgerald, Gerald C. Gerloff, and Folke Skoog.
Sewage and Industrial Wastes, Vol 24, No 7, p 888-896, 1952. 1 fig, 6 tab, 7 ref.

Descriptors: *Toxicity, *Cyanophyta, *Chemcontrol, Eutrophication, Bass, Water pollution control, Minnows, Nuisance algae, Sunfishes, Algae, Daphnia, Lakes, Chlorophyta, Streams, Diatoms, Reservoirs, Cultures, Sewage effluents, Wisconsin, Algicides, Hydrolysis, Copper sulfate, Fishes, Herbicides, Midges, Pesticides.
Identifiers: *Selective toxicity, Chemical structure, 2,3-dichloronaphthoquinone, Microcystis aeruginosa, Aphanizomenon flos-aquae, Minimum lethal doses, Chu's media, Quinone derivatives, Alkyl substituted imidazolines, Biological activity, Quarternary, Ammonium compounds, Minimum lethal exposure, Phenanthroquinone, Madison (Wis), Elodea, Redox compounds, Ceratophyllum, Myrophyllum, Rhizoclonium, Photobiology.

Procedures used and results of toxicity tests of 300 organic chemicals to Microcystis aeruginosa, a bloom-producing cyanophyte (blue-green alga) are described. Many compounds were toxic in concentrations in the range 1-10 parts/millon (ppm); several quinone-like compounds are toxic below 1 ppm, and one, 2,3-dichloronapthoquinone, is lethal at concentrations of 0.002 ppm. Apparently selectively toxic to nuisance cyanophytes, it is nontoxic to most green algae and higher plants, and has no shortterm deleterious effects on some fishes and invertebrates even when present in excess of saturation concentrations. Further study of this compound to rule out injurious effects to desirable species after long exposures are recommended. Age of cultures of Microcystis influence its response to the compound; centrifuged cells from both 6-day and 19-day cultures were markedly less sensitive when resuspended in old medium. This effect was partially counteracted after fortification of old medium with nutrients. Estimates of minimum lethal exposures indicate that compound is effectively toxic after 8-10 minutes treatment of cells. Limited field tests in barrels, tanks, and lagoons, containing dense growths of nuisance algae, principally Aphanizomenon flos-aquae, in lake water or sewage effluent, indicate that compound is effective in low concentrations (0.01-0.1 ppm). (Eichhorn-Wisconsin)
W70-02982

A REVIEW OF CHEMICAL MEASUREMENTS IN WATER POLLUTION CONTROL,
Federal Water Control Administration, Washington, D.C. Div. of Pollution Surveillance.
For primary bibliographic entry see Field 05A.
W70-02984

POLLUTION ABATEMENT IN THE RUHR DISTRICT,
Harvard Univ., Cambridge, Mass.
G. W. Fair
In: Comparisons in Resource Management, Baltimore, Johns Hopkins Press, p 142-171, 1961. 30 p, 1 map, 6 tab, 17 ref, 1 append.

Descriptors: *Pollution abatement, *Transportation, *Industries, *Waste water, *Taxes, Potable water, River basin, Canals, Boats, Streams, Government, Swamps, Watercourses, Reservoirs, Floods, Marshes, Sewers.
Identifiers: *Emschergenossenschaft, *Ruhr district.

This article deals with pollution abatement measures in the six river-basin associations of the Ruhr district. Urban and economic development in the region is explained as it relates to intensified competition for water, making the development and safeguarding of surface sources of drinking water and process water a primary concern. One river-basin authority has acted, without change, for over fifty years. This is the Emschergenossenschaft, whose history is briefly related in this article. The river-basin associations have served autonomously, levying assessments and distributing benfits policies with the approval of both private and public representatives. These associations are unique in obtaining compliance with their prescriptions through thorough representation, and their power to plan, design, build and operate needed installations for pollution abatement. This article discusses a smoothly functioning and effective pollution abatement system that will be of interest to those working in water pollution problems. (See Vol 2, No 24, Field 6B, entry W69-09952). (Murphy-Rutgers)
W70-03021

AGRICULTURAL CHEMICALS AND OUR WATER RESOURCES,
Purdue Univ., Lafayette, Ind. Dept. of Agricultural Engineering; and Purdue Univ., Lafayette, Ind. Dept. of Entomology.
For primary bibliographic entry see Field 05B.
W70-03065

SUMMARY OF WATER QUALITY STANDARDS FOR THE INTERSTATE WATERS OF ARKANSAS.
Federal Water Pollution Control Administration, Washington, D.C.

Federal Water Pollution Control Administration-Arkansas Pollution Control Administration Cooperative Report, Oct 1969. 21 p, 1 fig, 2 tab.

Descriptors: *Water quality act, *Water quality, *Standards, *Arkansas, Legislation, Water pollution, Water pollution control, Sewage treatment, Interstate, Water utilization.
Identifiers: *Arkansas water quality standards.

Arkansas adopted standards for its interstate waters on May 26, 1967, which were then submitted to the Department of the Interior. Subsequently, certain revisions were made by the State in the original standards, and the Secretary of the Interior approved the standards, as revised, on August 7, 1967. At the request of the Secretary of the Interior, Arkansas adopted a policy to protect its high quality waters. The approved standards are thus both State and Federal Standards, enforceable under the Arkansas water pollution control statutes and the Federal Water Pollution Control Act, as amended (Section 10). The standards consist of three major components: designation of the uses which the waters are to serve, specification of narrative and numerical criteria to protect and enhance water quality, and specification of a plan of implementation and enforcement, which includes treatment and control requirements for municipal, industrial and other wastes discharged to or affecting the waters. (Knapp-USGS)
W70-03083

WATER AVAILABILITY IN URBAN AREAS OF THE SUSQUEHANNA RIVER BASIN - A PRELIMINARY APPRAISAL,
Geological Survey, Albany, N.Y.
For primary bibliographic entry see Field 04B.
W70-03102

ILLINOIS WATER POLLUTION AND WATER RESOURCES COMMISSION, REPORT AND RECOMMENDATIONS TO GOVERNOR RICHARD B. OGILVIE AND THE 76TH ILLINOIS GENERAL ASSEMBLY.
Illinois State Water Pollution and Water Resources Commission, Chicago.

State of Illinois Water Pollution and Water Resources Commission, Final Report, May 1969. 8 p, 1 fig.

Descriptors: *Illinois, *Water pollution, *Water resources, DDT, Chlorinated hydrocarbon pesticides, State governments, Water law, Legal aspects, Planning, Water resources development
Identifiers: *Illinois Water Pollution and Water Resources Commission.

Beginning with a history of the Commission, recommendations from two previous Commission Reports, the 1967 report and the 1968 special report on Lake Michigan, were reviewed. Recent activities of the Commission were summarized also. The report concluded with four major recommendations for the 76th General Assembly: (1) A natural resource, or a water resource development, or a pure waters bond act should again be passed to be placed before the people of Illinois; (2) An effective system of controls should be placed on the use of DDT and possibly on all chlorinated hydrocarbons that present a substantial danger to wildlife and possibly to human beings when in concentration; (3) A restructuring of State government should be placed in effect at the earliest possible time for greater effectiveness in administering, managing, and coordinating controls and assistance for water and other natural resources. Preferably a Department of Natural Resources should be created; and (4) Illinois water laws should be reviewed and combined in a Water Code. (Davis-Chicago)
W70-03138

ELECTRONICS STARTS SOLVING THE PROBLEMS OF THE CITIES,
For primary bibliographic entry see Field 07B.
W70-03139

LAKE MICHIGAN OPEN WATER AND LAKE BED SURVEY 1968.
Illinois State Sanitary Water Board, Springfield.
For primary bibliographic entry see Field 05A.
W70-03140

COMBINED UNDERFLOW STORAGE PLAN FOR POLLUTION AND FLOOD CONTROL IN THE CHICAGO METROPOLITAN AREA,
Chicago Bureau of Engineering, Ill.
Clint J. Keifer, A. L. Tholin, and Marshall Suloway.
Chicago, City Bureau of Engineering, Department of Public Works, Sept 1969. 43 p, 13 fig, 6 tab.

Descriptors: *Underground storage, *Tunnels, *Control structures, *Sewers, *Flood control, *Water pollution control, Water conveyance, Waste water, Shafts, River regulation, Drainage systems, Drainage engineering, Design, Underflow.
Identifiers: *Chicago, *Metropolitan Sanitary District of Greater Chicago, Underflow storage plan.

Three alternative plans, proposed locally as solutions to flood control and pollution problems in the Chicago metropolitan area, are described and compared. The combined sewer systems, which carry the municipal and industrial wastes as well as storm water runoff, spill raw sewage into the Des Plaines, Chicago and Calumet Rivers and the Sanitary and Ship Canal from 400 outlets, during overflows occuring when interceptor sewers and treatment plants are loaded beyond capacity. The flow from these rivers empty via the Des Plaines River into the Illinois River. Intense rainstorms frequently

result in basement and underpass flooding. The $650 million plan suggested by the City proposes the construction of 95 miles of huge conveyance tunnels, 26 ft wide and 50 ft deep, excavated through solid rock beneath the Chicago, Calumet, and Des Plaines Rivers and the Sanitary and Ship Canal. Flows from the combined sewers would be dropped through shafts into these tunnels to provide temporary storage for flood prevention and to collect sewer overflows for subsequent pumping to three major existing treatment plants. Improvements along the Des Plaines River and the Sanitary and Ship Canals planned by the Illinois Division of Waterways are also described. The project design would be based upon handling the runoff from a storm with a 100 year average recurrence interval. (Poertner-Chicago)
W70-03142

EVALUATION OF ALTERNATIVE SOLUTIONS FOR ACHIEVEMENT OF RIVER STANDARDS,
Quirk, Lawler and Matusky, New York.
For primary bibliographic entry see Field 05B.
W70-03165

WATER QUALITY PLANNING IN THE PRESENCE OF INTERACTING POLLUTANTS,
Clemson Univ., S.C. Dept. of Environmental Systems Engineering.
For primary bibliographic entry see Field 05B.
W70-03168

TRANSPORT OF DISSOLVED WASTES IN RIVERS,
Federal Water Pollution Control Administration, Washington, D.C.; and Texas Univ., Austin. Center for Research in Water Resources.
For primary bibliographic entry see Field 05B.
W70-03174

PUBLIC HEALTH: DISPOSAL OF WASTE BY MUNICIPALITIES AND INDIVIDUALS THROUGH SEWAGE SYSTEMS.

Wis Stat Ann secs 144.05-144.07, 144.09, 144.10 (1957), as amended, (Supp 1969), 144.045, 144.14 (Supp 1969).

Descriptors: *Wisconsin, *Sewage disposal, *Sewage treatment, Administrative agencies, Water pollution, Watersheds, Cities, Streams, Lakes, Legal aspects, Treatment facilities, Conduits, Public health, Effluents, Refuse, Regulation, Drainage basins, Buildings, Sewerage, Sanitary engineering, Discharge, Legislation, Water treatment, Waste treatment, Water quality control.
Identifiers: *Enforcement, Penalties (Civil).

The outflow or effluent from sewage systems complying with section 144.04 may be discharged into any stream or drain constructed pursuant to law. No such outflow of untreated sewage may be discharged into lakes of a delineated size from a city in a county with a population of at least 240,000, any part of which is located within a drainage basin which drains within a minimum distance from the sewage systems. All necessary construction of plant facilities for the discharge of untreated sewage shall be completed by September 1, 1970. Advanced treatment of effluent may exempt owners of existing plants from these provisions. Municipalities with populations of more than 7,500 may require buildings used for human habitation to be connected with adjacent sewers or water mains. Penalties are provided for failure to comply. The Department of Resource Development may require the planning and construction of sewerage systems so that they may be connected. Adjacent municipalities may operate a joint system. Procedures for administering such a system are outlined. The Department of Resource Development is empowered to enforce its rules. Individual owners may secure a review of any order issued by the Department. (Duss-Florida)
W70-03189

WATER, ICE, SEWAGE AND REFUSE.

Wis Stat Ann secs 144.01-144.02, 144.04 (1957), as amended, (Supp 1969) 144.023-144.03 (Supp 1969).

Descriptors: *Wisconsin, *Water quality control, *Water pollution, *Sewage, Water supply, Water resources, Water quality act, Legislation, Water resources development, Water pollution control, Public health, Water treatment, State governments, Administration, Septic tanks, Sewage disposal, Sewage treatment.

The following terms are defined for purposes of this act: waters of the state, sewage, waterworks or water systems, water supply, sewerage systems, refuse, owner, industrial wastes, and pollution. The Department of Water Resources is authorized to act with the United States Geological Survey to determine the condition of polluted and unpolluted waters, the causes of pollution, including city sewage and industrial wastes, and the best sources of water supplies. Governmental owners must submit plans for sewerage systems to the Department of Water Resources for approval. A Department of Resource Development containing a Water Resources Division is created. The Department seeks to protect, maintain and improve the quality and management of the state's ground and surface waters. The purpose of this act is to centralize programs of water quality management in a single agency empowered to develop a comprehensive plan for protection of the public and private waters of the state. A State Water Resources Advisory advises the Department. The Department must divide the state into regions, each to be served by a regional director and regional advisory board. The installation of septic tanks is regulated. (Dye-Florida)
W70-03199

POLLUTION CONTROL: STANDARDS FOR SOLID WASTE DISPOSAL.
Wis Stat Ann secs 144.31, 144.43-144.46 (Supp 1969).

Descriptors: *Wisconsin, *Administrative agencies, *Solid wastes, *Waste disposal, Air pollution, Ultimate disposal, Water resources, Water management, Atmosphere, Industries, Standards, Construction, Flood plain zoning, Permits, Investigations, Landfill, State jurisdiction, Federal government, Shores, Research and development, Design, Treatment facilities, Pollutants, Regulation.

The Department of Resource Development shall have the power and duty to: promulgate rules; encourage local governments to handle local pollution problems; and organize a comprehensive program to improve and manage the state's air, land, and water resources. The Department may hold hearings, issue orders, secure necessary services, conduct investigations regarding emission from motor vehicles, and advise, consult, and cooperate with other appropriate governmental and private bodies. By January 1, 1969, the Department shall prepare and adopt minimum standards for the location, design, construction, sanitation, operation, and maintenance of solid waste disposal sites and facilities. Annual licensing of sites and facilities is required in order to secure compliance with these minimum standards. Local governments may apply more restrictive licensing standards. The Department may conduct research into matters concerning solid waste disposal. Unless authorized by the Department, solid waste disposal sites and facilities are prohibited within areas under the jurisdiction of shoreland and flood plain zoning regulations. (Duss-Florida)
W70-03202

CREATION OF TOWN SANITARY DISTRICTS FOR POLLUTION CONTROL AND WASTE DISPOSAL.
Wis Stat Ann secs 60.30-60.304 (1957), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Administrative agencies, *Drainage systems, *Waste disposal, Sewers, Sewage disposal, Sewage treatment, Drainage, Storm drains, Water works, Cities, Pumping, Construction, Jurisdiction, Real property, Public health, Legal aspects, Treatment facilities, Domestic wastes, Boundaries (Property), Sewage districts.
Identifiers: *Sanitary districts.

Town sanitary districts may be created for the purpose of purchasing, establishing, or constructing surface or storm water sewers, drainage improvements, sanitary sewers, or a system of waterworks, sewerage, or garbage disposal. The districts may sue and be sued in furtherance of these purposes. 'Sewerage' includes all construction for collection, transportation, pumping, treatment, and final disposition of sewage. Procedure for creation of a town sanitary district is set forth. Town districts may be created within metropolitan sewerage districts since it is the intention of the legislature to permit auxiliary sewer construction in addition to the main and intercepting sewers constructed by metropolitan districts. Town boards are vested with jurisdiction to establish town sanitary districts. Petitions requesting such districts must be submitted by a fixed percentage of affected landowners to the town boards. Open hearings must be held by the town board before the creation of a district can be approved. Judicial review of the board's action is made available. (Duss-Florida)
W70-03203

MUNICIPAL CORPORATIONS.
For primary bibliographic entry see Field 03D.
W70-03206

REGIONAL WATER AND SEWER DISTRICTS.

Ohio Rev Code Ann secs 6119.01, 6119.06 (Page 1953), as amended, (Supp 1970).

Descriptors: *Ohio, *Sewage districts, *Water supply, *Sewage disposal, Legislation, Legal aspects, Contracts, Leases, Regulation, Easements, Water purification, Sewage treatment, Construction, Maintenance, Operating costs, Drains, Dams, Reservoirs, Pumping plants, Cost allocation, Taxes, Assessments, Industrial wastes, Eminent domain, Canals, Compensation, Administrative agencies.

Specified areas may be organized as regional water and sewer districts for either or both of the following purposes: (1) to provide a water supply for domestic, industrial, and public use; or (2) to provide for the collection and disposal of sewage and other liquid wastes. Regional water and sewer districts are authorized to make regulations governing the control and operation of their services and facilities and to acquire or operate sewer systems, waterworks, filtration and purification plants, and sewage treatment plants. The districts may construct, acquire, and maintain drains, dams, sewers, reservoirs, holding basins, wells, intakes, pipelines, purification works, septic tanks, treatment and disposal works, and pumping stations. In addition, the districts have the following powers: to levy and collect taxes or special assessments; to deal in real or personal property and franchises to carry out the purposes of the district; to merge or combine with any other district to form a single district; to contract with any other political subdivision for the joint construction of any works they are authorized to construct; and to construct or alter any ditch, drain, or watercourse. (Keith-Florida)
W70-03210

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

OPERATIONS RESEARCH IN OUTDOOR RECREATION,
Battelle Memorial Inst., Columbus, Ohio.

Frank J. Cesario, Jr.
Journal of Leisure Research, Vol 1, p 33-51, Winter 1969. 19 p, 7 fig, 21 ref.

Descriptors: *Operations research, *Recreation, Population, Administration, Benefits, Highways, Regression analysis, Demand schedule, Supply, Demand.
Identifiers: Recreational travel flow, Recreation system, Population centers, Recreation sites, Gravity models, Linear systems analysis, Clawson-Knetsch technique.

A major concern of public administration is how to provide enough outdoor recreation services to satisfy the recreation-seeking public. Assuming that more recreation sites are to be provided, the problem becomes one of deciding what facilities to provide and where to locate them. To answer these questions rationally and to properly allocate the limited funds available, the economic benefits of various alternative projects need to be estimated. This problem can be studied by the methods of operations research. Work to date has shown an interesting dichotomy. Some analysts (mostly operations researchers) have been developing models to predict recreational travel flow. Other analysts (mostly economists) have been working on problems relating to the economic benefits of outdoor recreation developments. The purpose of this paper is threefold: first, the work of the two groups studying outdoor recreation is reviewed; second, it is shown that we cannot conveniently separate the estimation of benefits from the estimation of recreation travel flow, and third, some suggestions for new directions of research are given. The importance of water resources in outdoor recreation make this article of interest to the water planner. (Loeb-Rutgers)
W70-02987

A NOTE ON 'GRAPH-THEORETICAL APPROACHES TO THE THEORY OF SOCIAL CHOICE',
Resources Management Corp.
George M. Lady.
Public Choice, Vol 6, p 93-98, Spring 1969. 6 p, 4 ref.

Descriptors: Social aspects.
Identifiers: *Graph-theoretical approaches, *Social choice, Ranking, Intransitivity, Interpersonal comparisons, Quantitative problems.

The author discusses a method introduced by Professor M. Taylor for considering the problem of combining individual rankings. More specifically, Professor Taylor proposed an ingeneous application of graph theory to the problem of combining individual rankings into a group ranking. This note provides three classes of commentary. First, the analytical relationship between the structure of the individual rankings and the existence of intransitivity is somewhat consolidated. Second, certain quantitative difficulties are identified. Last, the problem of interpersonal comparison is reopened in the context of the computational scheme suggested by the paper. The author concludes that the graph theoretical approach is extremely useful although it does not entirely escape the problem of inter-personal comparisons. The problems of group decisions and interpersonal comparisons are present in water investment decisions and this article will be of interest to water researchers investigating decision processes and decision effects of water development projects. (Loeb-Rutgers)
W70-02992

THE INVESTMENT DECISION UNDER UNCERTAINTY,
Donald Eugene Farrar.
Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 1962. 90 p.

Descriptors: *Investment, *Risks, Decision making, Return
Identifiers: *Investment decision, Expected return, Certainty equivalence, Mathematical programming, Classical utility theory, Collinearity, Portfolios, Goodness of fit test, Capital theory.

Both the importance and the generality of uncertainty require that it be built into any theory that purports to explain a large portion of man's behavior. Economists have long been conscious of the need to more adequately account for its effect on such decision making units as the consumer and the firm. Capital theory, in particular, has felt the inadequacy of theories which ignore uncertainty's role in the investment decision. The author proposes to build a model so as to analyze decision making under uncertainty. This approach relies on only two substantive proposals: (1) an investor's utility of money function is positively sloped and concave downward, and (2) his investment strategy is the maximization of expected utility. The model is a direct descendant of classical utility theory. It can also be linked to the certainty equivalence tradition of risk aversion. Finally, it is also a mathematical programming approach to decision making under uncertainty. The model appears to describe the portfolio policies of mutual funds quite well. It is probable that with additional constraints, its applicability as a model of the investment decision under uncertainty may be quite general. If this is the case, such a model should prove quite useful in the water area where investment decisions are made with uncertainty and risk. (Loeb-Rutgers)
W70-03003

ECONOMIC MEASURE OF EFFECT OF EXTREME DATA,
Harvard Univ., Cambridge, Mass. Dept. of Engineering and Applied Physics.
For primary bibliographic entry see Field 06B.
W70-03091

COMPUTER SIMULATION PROGRAMMING: AN AID TO THE SELECTION AND MANAGEMENT OF CENTER PIVOT SPRINKLER SYSTEMS,
North Dakota State Univ., Fargo. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 03F.
W70-03162

IMPORTANCE OF MATHEMATICAL METHOD AND COMPUTING TECHNIQUE APPLICATION TO WATER RESOURCE PLANNING AND CONTROL,
All-Union Research Inst. for Water Engineering and Reclamation, Moscow (USSR).
L. V. Dunin-Barcovsky.
The Use of Analog and Digital Computers in Hydrology, Vol 2, p 682-686, 1969. 5 p, 4 ref.

Descriptors: *Mathematical models, *Water resource development, *Optimization, *Planning, *Linear programming, Stochastic processes, Water works, Reservoirs, Multiple-purpose, River basins, Computers.
Identifiers: Operating schedules.

The development and use of linear and non-linear programming techniques and mathematical models for optimum planning and management of water resources in the USSR were discussed. The stochastic nature of the initial parameters of water works systems enabled the collection of reliable data about possible strategy and tactics for an optimum control which was necessary for the determination of optimum system parameter. The use of such characteristics as operating schedules for water reservoirs and water supply to consumers was an important element of optimum control. The optimization of operational systems was aimed at selecting optimum parameters and the operational system was used for modelling the operational process with the purpose of determining the optimization degree received. The management of the multiple-purpose Zeravshan river basin was given as an example. Computers were employed for data processing. (Thiuri-Cornell)
W70-03166

NEW METHODS FOR USING STOCHASTIC PROCEDURES IN WATER RESOURCE PLANNING,
Computer Technology, Inc., Arlington, Tex.
Jerry R. Rogers, and Ronald L. Boase.
Report to Tex Water Develop Board, Computer Technol Inc, Math-Sci Sect, Sept 1969. 45 p, 9 fig, 12 tab, 24 ref.

Descriptors: *Stochastic processes, *Synthetic hydrology, *Water resources development, *Planning, *Streamflow forcasting, *River basins, Hydrological data, Reservoir operation, Economics, Mathematical models.
Identifiers: Linear regression models.

Current stochastic models as well as a discussion on proper procedures for generating data for use in testing alternative plans for river basin improvement were presented. Existing data sources for Texas Water plan and their utilization in the stochastic models were reviewed. Linear regression models for relating the streamflow in one time period to a linear function of the flow in preceeding time period were compared. The Weibull distribution was considered as a possible candidate for filting hydrological data. To test the applicability of the Weibull distribution to meaningful data the historical flow rates for the Salt Fork branch of the Brazos River was selected. At least nine to ten random sets of 50 or 100 years of stochastic data would be applied to the Texas Water Plan reservoir-transmission analysis to provide; (a) experience on system economic and physical performance under a wide variety of potential streamflows and; (b) measures of the risks involved for various reservoir-transmission capacities and construction dates. (Thiuri-Cornell)
W70-03171

MATHEMATICAL MODELS FOR OPTIMIZING THE ALLOCATION OF STORED WATER,
Nevada Univ., Reno. Center for Water Resources Research.
W. S. Butcher.
The Use of Analog and Digital Computers in Hydrology, UNESCO, Vol 2, p 714-723, 1969. 10 p, 23 ref.

Descriptors: *Mathematical models, *Optimization, *Resource allocation, *Linear programming, *Dynamic programming, Simulation analysis, Stochastic processes, River basins, Monte Carlo method, Hydrologic data, Hydro-electric power, Streamflow forecasting, Water storage.

The use of linear and dynamic programming techniques in various mathematical modeling methods capable of determining the optimal allocation of available water was discussed. To illustrate the alternative methods and their limitations, a river basin was examined. It was clear that if historical or known hydrological data was available, the optimum operation of a reservoir could be calculated directly by either linear or dynamic programming. However, if hydro-power was involved the linear programming formulation became clumsy and was not the best choice. Even without this, dynamic programming was to be preferred as it was simpler more direct and involved less computation. Dynamic programming under stochastic condition whether the Monte Carlo method or the true stochastic dynamic programming was superior to the alternatives available in streamflow determination and management. Simulation was essentially a 'what if' process, that is, for its use it was necessary to specify a proposed operating rule and see what happened if it was used. (Thiuri-Cornell)
W70-03173

USE OF SYSTEMS ANALYSIS METHODS IN DETERMINING NEEDS AND IMPLEMENTING PROGRAMS FOR WASTE TREATMENT FACILITIES.
Federal Water Pollution control Administration, Washington, D.C.
For primary bibliographic entry see Field 05D.
W70-03176

6B. Evaluation Process

DELAWARE RIVER COMPACT.

Pa Stat Ann tit 46, sec 251 (1969).

Descriptors: *Pennsylvania, *Delaware River, *Regulated flow, *Water conservation, Legislation, Municipal water, Domestic water, Interstate rivers, Interstate compacts, River basins, New York, New Jersey, Water resources, Water utilization, State governments, Equitable apportionment, Legal aspects, Water supply, Beneficial use.

The Governor may appoint three commissioners to negotiate a compact with duly authorized agents of New York and New Jersey. The compact is for the regularization of the flow of the Delaware River, the conservation of the water resources of the Delaware Basin, the apportionment of these water resources for domestic and municipal supply, and the utilization thereof for power and other beneficial uses. (Schram-Florida)
W70-02932

ATLANTIC STATES MARINE FISHERIES COMMISSION.
Pa Stat Ann tit 30, secs 411-414, 417 (1958).

Descriptors: *Pennsylvania, *Interstate compacts, *Interstate commissions, *Marine fisheries, Water resources development, State governments, Administrative agencies, Cost allocation, Federal government, Political aspects, Leadership, Fish stocking, Legislation, Planning, Surveys, Investigations, Legal aspects, Research and development, Atlantic Coastal Plain, Fish conservation, Marine fish, Anadromous fish, Shellfish, Coordination.
Identifiers: Atlantic states.

The Governor of Pennsylvania is authorized to execute the Atlantic States Marine Fisheries Compact. The purpose of such compact is to promote the better utilization of the marine, shell, and anadromous fisheries of the Atlantic seaboard, by the development of a joint program for the promotion, protection, and prevention of physical waste of such fisheries. Each state joining shall appoint representatives to the Atlantic States Fisheries Commission which shall be constituted and organized as herein provided. The Commission shall have the powers and duties to: (1) conduct studies; (2) recommend coordination of the police powers of the several states; (3) recommend legislation; (4) advise state administrative agencies; and (5) recommend the stocking of waters. The states joining the Compact agree to make annual appropriation to the support of the Commission. The initial annual appropriation is set forth for each state. The Fish and Wildlife Service of the Department of the Interior of the United States shall act as the primary research agency of the Commission. Pennsylvania officers and bureaus are directed to cooperate with the Commission. (Marsee-Florida)
W70-02935

PLANS FOR MULTIPLE USE OF THE WATER RESOURCES IN THE LENA RIVER,
F. V. Iarosh.
Gidrotekh Stroit, No 1, p 1-8, 1966. Transl from Russ, Bur Reclam Transl 694, Oct 1969. 31 p, 5 fig, 5 tab.

Descriptors: Water resources, Project planning, Earth dams, Cold weather construction, *Multiple-purpose projects, Multiple use, Optimum development plans, Preliminary investigations, Foreign projects, *River basin development, Permafrost, Engineering geology, Dams, Hydroelectric plants, Feasibility studies, Hydroelectric power.
Identifiers: Comparative studies, Hydroelectric resources, Lena River Basin (USSR), Lower Lena Powerplant (USSR), Resources development.

The Lena River Basin, producing the second largest river discharge in Siberia, can provide the USSR with multiple benefits if properly developed for full use of the water resources for navigation, power, industry, mining, and forestry. Geography, climate, hydrology, and engineering geology of the Lena and 5 main tributaries, the Kirenga, Vitim, Olekma, Aldan, and Viliui Rivers, are described. A map of the river basin shows 60 hydropowerplant sites, including alternatives. The earth dam alternative at the Lower Lean site with backwater up to Iakutsk is discussed. The plan includes an earth dam, diversion canal, tunnel spillway, tunnel penstocks, and powerplant on the left bank with an installed capacity of 20,200 mw and annual output of 98.5 billion kwhr/yr. Power will be transmitted 3,500 km through the Central Siberian Grid to the Ural industrial area, although future planning will include cost comparison of constructing power-consuming industries near the powerplant. Construction will be difficult because of the remoteness of the area, lack of transportation facilities, severe arctic climate, permafrost, large flow and swift deep current through the Lean narrows, and magnitude of the construction work. (USBR)
W70-02949

WATER AS A RESOURCE AND AS A NUISANCE,
Geological Survey, Menlo Park, Calif.
Harold E. Thomas.
Highw Res Rec, No 271, p 17-28, 1969. 12 p, 17 ref.

Descriptors: *Water resources development, *Water, Water resources, Water utilization, Benefits, Hydrologic cycle, Damages, Bibliographies, Statistics, Urbanization, Rainfall effects, Minerals, Surface runoff, Land resources, Flood protection, Wastes, Atmospheric precipitation.
Identifiers: Urban hydrology.

Water as a resource is available for use and enjoyment by mankind. Consumptive uses reduce the quantity, and nonconsumptive uses may impair the quality of water available for use by others; various laws protect the respective rights of individuals in water use. Although water rights are protected as property rights, recognition of rights of the public and responsibilities of water users for maintenance of satisfactory quality are increasing. Water may constitute a nuisance if it harms development of land resources and invades recognized property rights. Conversely, development of land resources may have effects that interfere with the water rights of others, causing a nuisance. In urban areas, water as a resource becomes increasingly inadequate to meet requirements of the population and must be imported, along with food, fuel, and other materials. Generally in urban areas, water supply and disposal of used water have become public responsibilities. Urbanization changes the hydrology of an area in total runoff, peak flow characteristics, water quality, and appearance of lakes, streams, and valleys. To predict, ameliorate, or otherwise cope with these changes, urgent need exists for additional research in urban hydrology. (USBR)
W70-02959

ECONOMIC EVALUATION OF ENGINEERING PROJECTS,
Canada Ltd., Toronto (Ontario).
W. B. Magyar.
Engineering Economist, Vol 13, No 2, p 67-85, Winter 1968. 19 p, 4 charts, 20 ref.

Descriptors: *Environment, *Decision-making, *Engineering, *Design, Investment, Capital, Economic feasibility, Optimization, Economic evaluation, Computers, Research and development, Management, Budgets, Risks, Costs, Water consumption, Taxes.
Identifiers: *Stage-wise approach, Cash-flow analysis, Public works projects, Project business model.

The economic and technical feasibility of engineering projects was studied. Economic evaluation in such projects has been inadequate due largely to the absence of a good general framework for probing economic feasibility. Improvement and standardization of economic evaluation would help industry and government cope with proposed capital expenditures. Preliminary estimates for such expenditures should be an integral part of broad planning within the total environment involved. The recommended approach is therefore a general and stage-wise one which will furnish such information to improve decision-making. The time and costs involved in such extensive economic evaluations will be offset by savings from rejections of unsound programs. This method is especially applicable to water resource projects, due to the important role they play in the total environment quality. (Murphy-Rutgers)
W70-02986

ECONOMIC ANALYSIS OF PROJECTS FOR SECONDARY SOURCES OF WATER SUPPLY,
Ford, Bacon and Davis, Inc., New York.
John L. Rose.
Journal of American Water Works Association Vol 54, No 11, p 1361-1369, Nov 1962. 9 p.

Descriptors: *Investment, *Water supply, Economic analysis, Technology, Water resource development, Costs, Capital, Computers, Optimization, Demand, Interest rate, Discount rate, Engineering, Benefits.
Identifiers: *Staged construction, *Capacity.

This article discusses the factors entering into the economic analysis of projects for secondary water supplies and into the techniques for making the analysis. The factors discussed are: (1) the capacity of the proposed improvement, including the firming effect on the primary source of supply; (2) the conjectural nature of the demand projections; and (3) the susceptibility of alternative plans to staged construction. The choice of the formula to be used for deciding between the design alternatives is discussed as well as the rate of interest to be used to place events occurring at different times on a common basis. The author finds that the general tendency of the factors studied is to reduce the initial investment and to incur higher operating costs in the later stages of development. (Murphy-Rutgers)
W70-02990

ASSESSING THE DEMAND FOR OUTDOOR RECREATION,
George Washington Univ., Washington, D.C.
Jack L. Knetsch.
Journal of Leisure Research, Vol 1, No 1, p 85-87, Winter 1969. 3 p.

Descriptors: *Recreation demand, *Demand, *Recreation, Recreation facilities, Investment, Planning, Population, Prices, Supply.
Identifiers: Participation.

Due to increases in the use of recreation facilities, large investments are being made in this area and planning efforts are needed to improve the allocation of these investments. However, there is a lack of appropriate studies designed to guide these planning efforts. The author argues that outdoor recreation demand studies are often used in an inappropriate and incorrect manner. Problems are introduced by the methods which population data are employed. Recreation demand has often been used misleadingly due to the confusion of the recreation 'demand' terminology. Ambiguity enters principally at two points which make many so-called demand studies nearly useless as guides to planning recreation investment: The first is based on the premise that price-quantity relationships which lie behind the concepts of demand and supply should be ignored. A second difficulty is that so-called 'demand' is not demand at all. Often participation rates are influenced by both demand and availability of supply. The author argues that the single most serious and fundamental deficiency in demand surveys and studies is that they do not provide any means of determining how recreation use will respond to changes in supply. Recreation demand studies, to be useful for planning purposes must consider the effect of both demand and

supply factors on recreation use. The crucial role of water in outdoor recreation and the dollar benefits assigned to recreation in water projects make this article relevant to the water area. (Loeb-Rutgers)
W70-02993

A RESOURCE ECONOMIST VIEWS A NATURAL AREA,
Vermont Univ., Burlington.
Frederic O. Sargent.
Journal of Soil and Water Conservation, Vol 24, No 1, p 8-11, Jan-Feb 1969. 4 p.

Descriptors: *Resource allocation, Economic impact, Resource development, Decision making, Political aspects, Planning, Cost-benefit analysis, Economics.
Identifiers: *Resource economist, *Natural area, Free market, Economic principles, Economic methods, Opportunity costs, Resource development potential, Economic impact analysis.

Economists concern themselves with objective studies of costs, returns, benefits, allocation of cost, efficiency of resource use and resource distribution. All of these subjects have a bearing on decisions concerning natural resources. The author discusses the difference between resource economists and other economists. The difference hinges on the concept of the dominant resource allocating mechanism. Nonresource economists, be they specialized in production, marketing, business, investments, or other areas have one thing in common: They are all devoted to the proposition that the free market is the prime resource allocating mechanism in our society and that it handles the job of allocating resources well. The resource economist is devoted to the proposition that the political process in which government action at various levels controls, guides, and regulates the use of natural resources is the prime allocating procedure with respect to natural resources. The author continues by discussing how the resource economist views a natural area. He studies a natural area with reference to basic principles and by methods developed over a period of time that have been shown to be useful in making resource allocation decisions. These principles and methods are of two kinds, (1) planning and (2) economic principles and methods. (Loeb-Rutgers)
W70-02994

STRATEGIC INTERACTION AND RESOURCE ALLOCATION IN METROPOLITAN INTERGOVERNMENTAL RELATIONS,
Massachusetts Inst. of Tech., Cambridge.
Jerome Rothenberg.
AER, Vol 59, No 2, p 494-503, May 1969. 10 p.

Descriptors: *Resource allocation, *Governments, Sites, Cities, Costs, Welfare.
Identifiers: *Strategic interaction, Metropolitan area, Suburbs, Privacy, Locational advantages, Public policy, Land value, Variable sum strategic game, Residential location decisions.

The model presented in this paper concerns the influence that local government in a metropolitan area has on the distribution of economic activities within the area. The basic situation here is that a single metropolitan area government does not exist but a set of independent political jurisdictions is present. In this model the area is assumed to be partitioned into a central city jurisdiction and a single suburban jurisdiction, both of constant area. Certain policy instruments controlled by these jurisdictions are assumed to influence the location decisions of households and business. The model indicates how these instruments are used in a way to exert conflicting influences on such decisions such that the respective opposing pulls are akin to a process of strategic interplay between two players in a variable sum strategic game. As such, this paper might provide insights on the influential effect of government actions on water resource investment projects conducted on a regional or interlocality basis. (Loeb-Rutgers)
W70-02995

AN ECONOMIC THEORY OF SOCIAL MOVEMENTS,
London School of Economics and Political Science (England); and Johns Hopkins Univ., Baltimore, Md.
Albert Breton, and Raymond Breton.
AER, Vol 59, No 2, p 198-205, May 1969. 8 p, 1 fig.

Descriptors: *Economics, Demand, Supply, Environment, Growth rates.
Identifiers: *Social movement, Socioeconomic factors, Demand for social change, Supply of social movements.

Social movements do not make their appearance at random; instead they tend to emerge in relatively well-defined circumstances and to be accompanied by identifiable socioeconomic factors. In this paper the authors develop a hypothesis about the origin of social movement. The paper is divided into three parts: the first elaborates a theory of the demand for social change or, more specifically, a theory about why the demand for change manifests itself in social movements. This first part, in turn, is subdivided into two sections examining: first, some structural components of the environment in which social movements originate and, second, the definitions and assumptions of the proposed theory as well as its essential mechanisms. The second part introduces the concept of the supply of social movements and examines how this supply is related to the demand for social change. This discussion sheds some new light on the question of social change itself. Social change and its political effects can have significant implications for the public goods area. Water resource development involves all the problems of the public sector and this article may be of general relevance to relating social and institutional factors into studies of water resources. (Loeb-Rutgers)
W70-02998

ECONOMIC CONSIDERATIONS FOR THE DESIGN OF WATER INSTITUTIONS,
Indiana Univ., Bloomington.
Jerome W. Milliman.
Public Administration Review, Vol 25, No 4, p 284-289, Dec 1965. 6 p.

Descriptors: *Economics, Administration, Institutions, Water allocation, Water management, Water resources development, Water law.
Identifiers: *Water institutions, Regional economic growth, Water crisis, Public agencies, Efficiency.

The problem of how best to allocate water resources should be viewed as part of an overall management problem in the use and development of water resources and not simply as a problem of allocation of water resources among competing uses. The problem of allocation needs is to be considered within a management framework which is capable of comprehending the major technological, hydrologic and economic relationships of water resource management. The allocation of water resources involves wise choice in all the uses of water and also efficient use of all complementary resources intimately related to water resource development and regional economic growth. Our water problems are largely ones of inadequate institutional arrangements for management of water resources and failure to use economic principles. Two alternatives are suggested for consideration in the choice of decision-making frameworks, the regional basin authority and greater use of the market system through improvement in water law. The author suggests that some combination of the two would be desirable and feasible for greatly improving the management of our water resources. (Loeb-Rutgers)
W70-02999

THE USES OF ECONOMIC RESEARCH,
National Bureau of Economic Research, New York.
Solomon Fabricant.
43rd Annual Report, National Bureau of Economic Research, NY, p 1-4, May 1963. 4 p.

Descriptors: *Economics, *Forecasting, Economic analysis, Measurement, Government, Taxes, Economic investigations, Social impact.
Identifiers: *Economic research, *Economic concepts, *Quantification, *Economic behavior, *Research aims, Economic policy.

Economic research is aimed at strengthening the ability of economics to better human life. Knowledge for its own sake is not the main objective of economic research. It should aim at: clarifying the concepts and terminology used in discussing economic problems; devising measurements that permit objective assessment of significant economic quantities; compiling significant information on economic facts; observing and explaining economic behavior; drawing implications of changes of structure in our economy; aid in forecasting and estimating the probable consequences of policies. Due to the importance of economic research in much of the water resource area, this general discussion of the purposes of research should be of interest to the water researcher. (Murphy-Rutgers)
W70-03001

UTAH'S FUTURE WATER PROBLEMS,
Wayne D. Criddle.
Utah, Utah State University, 1958. 19 p.

Descriptors: *Utah, Urbanization, Legal aspects, Social aspects, Water law, Water supply, Soils, Irrigation, Drainage, Water utilization, Water resources development.
Identifiers: *Water problems, Technical problems, Instruments, Water research.

Utah is rapidly changing from what was once predominately an agricultural state to an urban and industrial state. This shift is intensifying the water needs of the state and creating many new problems. These changes involve technical, legal, sociological and economic problems never before encountered. Before attempting to look at Utah's water problems of the future, the author reviews the developments that have taken place in the past. The author then discusses the areas of water laws, limited technical knowledge of water supply, knowledge of soils, irrigation facilities, water uses and research in water use and development. (Loeb-Rutgers)
W70-03004

ADMINISTRATIVE DECISION MAKING,
Carnegie Inst. of Tech., Pittsburgh, Pa.
Herbert A. Simon.
Public Administrative Review, Vol 25, No 1, p 31-37, Mar 1965. 7 p.

Descriptors: *Decision making, Administrative decisions, Administration, Operations research.
Identifiers: *Administrative decision making, Management science, Optimality, Persuasion, Evocation.

Decision-making concepts and language have become highly popular in papers concerning administration. This paper describes some of the progress that has been made over the past quarter century employing this approach towards furthering the scientific knowledge of what new facts have been learned about human behavior in organizations, what new scientific procedures have been developed for ascertaining facts, what new concepts have been made for describing and explaining these facts. This progress extends both to descriptive and normative matters: to the pure science of administration, and its application to the practical business of managing. As such, this article may present insights in administrative decision making applicable to the water area. (Loeb-Rutgers)
W70-03007

TECHNOLOGY IN AMERICAN WATER DEVELOPMENT,
Edward A. Ackerman, and George O. G. Lof.
Baltimore, Maryland, The Johns Hopkins Press, 1959. 710 p.

Descriptors: *Technology, *Water resources development, Administration, Political aspects, Water utilization, Water demand, Water supply, Water quality, Transportation, Irrigation, Water control, Groundwater, Sea water, Runoff, Flood control.
Identifiers: Public administration, Geographical aspects, Water quantity, Recycling, Administrative organization.

This volume is an exploratory study with the objectives of: (1) providing a review of the past technical changes important in water development, and the construction of a meaningful classification of such technical events; (2) an appraisal of the socially and economically relevant technical subjects suitable for more detailed study; and (3) an appraisal of the manner of studying the relation between technology and administration of water development in the United States. The greater part of the study treats the proven technology which has influenced water development in the past or which still is effective in shaping its course. However, the study also treats the newer technology. This may have only modest immediate significance, but its potential importance is large. What this emerging technology may mean in terms of the evolving technological structure of water development in the United States is considered in the last chapter of this study. (Loeb-Rutgers)
W70-03008

NATURAL RESOURCES FOR U S GROWTH,
Resources for the Future, Inc., Washington, D.C.
Hans H. Landsberg.
Baltimore, Maryland, The Johns Hopkins Press, 1964. 260 p.

Descriptors: *Natural resources, *Water supply, Water uses, Withdrawal, Income, Water demand, Irrigation, Technology, Water quality, Dissolved oxygen, Regional analysis, Agriculture, Gross National Product, Construction, Transportation, Demand.
Identifiers: *Future requirements, *Resource adequacy, On-site uses.

This is an examination of the adequacy of natural resources in the United States over the rest of the century. The broad prospects for the economy as a whole are discussed with projections made of GNP, various types of spending, and the expected advances in technology. Future requirements for living are considered as well as what they appear to mean in terms of needs for the various natural resources and their products. The availability of resources to meet these projected requirements is considered. Although much of the discussion is applicable to water resources there is a substantial section devoted specifically to water. The unique characteristics of water use and problems are considered along with demand indicators, depletion for specific withdrawal and nonwithdrawal uses, the requirements for water quality, as well as the characteristics and adequacy of future water supply. In the last section some of the chief policy issues suggested are reviewed. (Murphy-Rutgers)
W70-03011

THE SOCIAL SCIENCES AND AMERICAN CIVILIZATION,
Bruce Watson, and William Tarr.
New York, John Wiley and Sons, Inc, 1964. 584 p.

Descriptors: *Institutions, Political aspects, Economics, Community development, Schools, Military aspects, Gross national product, Income, Resource allocation, Management.
Identifiers: *Social sciences, *American civilization, *Socialization, *Economic institutions, *Political institutions, Personality, Human group, Urban society, Traditional society family, Church, Capitalism, Economic roles, Democracy, Classical view, Income distribution, Economic revisionist, Entrepreneur, Consumption.

The point of view found in this book is based on the interrelatedness of knowledge in the social sciences. The authors have selected some of the major themes and concepts from the behavioral sciences and have applied these to various trends and institutions of American civilization. The study of American trends and institutions has been placed in a historical context as an aid to the application of concepts. For example, in the study of economic institutions the historical development of capitalism as a form of social organization and as an ideology are discussed before the strictly behavioral subject matter. The concepts introduced throughout the book are illustrated and elaborated by the frequent inclusion of the works of other authors. Part one of the book is devoted to four tools of analysis which form the analytic basis of the list. Part two deals with the nature of the human community; Part Three and Four with the socialization process; Part Five with the economic institution; Part Six with political institutions, and Part Seven with certain unsolved problems in American civilization. This volume provides the water manager and water researcher with a broad picture of the institutions within which social decisions are made as well as specifically reviewing some of the trends in economics and management. (Loeb-Rutgers)
W70-03012

PUBLIC INVESTMENT CRITERIA,
Massachusetts Inst. of Tech., Cambridge.
Stephen A. Marglin.
Cambridge, Massachusetts, The MIT Press, 1967. 103 p.

Descriptors: *Cost-benefit analysis, *Investment, *Government, Economics, Capital, Discount rate, Economic efficiency, Pricing, Costs, Regional analysis, Indirect benefits, Budgeting, Dynamics, Economic evaluation.
Identifiers: *Public investment, *Intertemporal criteria, *Investment objectives, Redistribution, Willingness-to-pay, Merit-want, Investment timing.

This book explores some of the theoretical problems of subjecting public investment decisions to cost-benefit analysis. A short history of cost-benefit analysis is presented, followed by an analysis of the objectives relevant to investment planning, along with the methods of specifying their relative importance. The different types of possible benefits and their relation to objectives as well as costs are discussed. The fact that the meaning of benefits and costs varies from objective to objective is stressed. The choice of an intertemporal criterion receives significant space and the author proposes weights be imposed on each contribution to each objective in each time period. The role of uncertainty is evaluated as well as the effects of secondary benefits and private alternatives to public investment. A brief discussion of the applicable principles of pricing concludes the book. Both the large role of government and the increased use of cost-benefit analysis in water resources make this book useful to the water researcher. (Murphy-Rutgers)
W70-03016

THE BENEFITS FROM WATERSHED DEVELOPMENT,
Soil Conservation Service, Washington, D.C.; Tennessee Valley Authority, Knoxville; and North Carolina State Univ., Raleigh.
Erwin C. Ford, Elco L. Greenshields, and Fletcher E. Riggs.
In: Economics of Watershed Planning, p 27-41, Iowa State University Press, Ames, 1961. 15 p, 1 fig, 2 tab.

Descriptors: *Benefits, Geographical regions, Planning, Water management, Municipal water, Industrial water, Drainage, Irrigation, Recreation, Wildlife, Competition.
Identifiers: Watershed development, Complementarity, Public Law 566, Watershed projects, Wildlife benefits, Flood prevention.

This paper attempts to give perspective to benefit issues confronting planners. It concentrates on physical and economic factors conducive to different kinds of benefits. It also considers whether, in securing one type of benefit, the expense of securing other benefits is affected or, in other words, whether complementarity or competitiveness exists between benefits. This chapter is based partly on benefit estimates taken from Public Law 566 watershed work-plans. For classifying the projects, the country was divided into 13 regions. The regional breakdown conforms to physiographic and economic characteristics. It has been designed to contain the minimum number of regions necessary for reasonable homogeneous groupings of projects. The first part of the chapter describes the benefits with which the small watershed program is concerned under Public Law 566 and related laws. Results from project plans through time and by regions are presented. The second part concerns some hypotheses to explain geographic distribution of benefits. Finally, issues surrounding benefits in the planning process are considered. (See Vol 2, No 14, Field 6B, entry W69-05718). (Loeb-Rutgers)
W70-03018

APPLYING ECONOMIC PRINCIPLES IN WATERSHED PLANNING,
Department of Agriculture, Washington, D.C.
George A. Pavelis.
In: Economics of Watershed Planning, p 151-164, Iowa State University Press, Ames, 1961. 14 p, 2 fig, 3 tab.

Descriptors: Economics, *Welfare resource allocation, Cost-benefit analysis, Benefits, Costs, Linear programming, *Watersheds.
Identifiers: *Watershed planning, *Nepper watershed.

Watershed development can be viewed as a welfare-oriented economic reorganization in which welfare may be increased by two means: (1) a more efficient allocation of resources currently available to the reorganizing participants, and (2) an efficient allocation of additional resources made available for development purposes. According to modern welfare theory, welfare in the aggregate can be increased only to the extent the welfare of any individual participant would not be decreased by reason of watershed programs being carried out. The crux of watershed planning may be viewed as finding the adjustments in resource use required to increase welfare as much as possible. The resource adjustments are reflected by changed systems of land use or by the installation of water control structures. These are referred to, respectively, as land treatment measures and structural measures. The planning framework used in the Nepper watershed is presented which shows how to combine measures so as to achieve maximum net benefits, subject to any specified restriction. Linear programming was illustrated as a useful supplement to conventional benefit-cost analysis for solving comprehensive watershed planning problems on a multipurpose basis. (See Vol 2, No 14, Field 6B, entry W69-05718). (Loeb-Rutgers)
W70-03019

ORGANIZATION FOR WATERSHED PLANNING IN THE PUBLIC INTEREST,
Tennessee Valley Authority, Knoxville.
Robert E. Lowry.
In: Economics of Watershed Planning, p 246-259, Iowa State University Press, Ames, 1961. 14 p.

Descriptors: Water resources, Flood control, *Water management, Economics, Planning, Cost sharing, *River basin development.
Identifiers: *Watershed planning, *Public interest.

Three issues of watershed planning are considered. The first states that the organization of the national watershed program according to local units, with the transient characteristics inherent in the project approach, tends to remove watershed development

from the normal channels through which most public services are administered and financed. The result is that this activity is an appendage to public policy rather than an integral part of it. The second issue raised is that separate economic justification of watershed projects impairs opportunity to view in wider perspective the contribution watershed planning can make to water management and economic development for nation and region. A third concern is what might be done organizationally to establish watershed planning and development more firmly as a national program within a framework of federal and state policy. (See Vol 2, No 14, Field 6B, entry W69-05718). (Loeb-Rutgers)
W70-03020

MULTIPLE PURPOSE LAND AND WATER DISTRICTS IN ONTARIO,
University of Western Ontario, London.
E. G. Pleva.
In: Comparisons in Resource Management, Baltimore, Johns Hoptkins Press, p 189-207, 1961. 19 p, 2 map.

Descriptors: *Watersheds, *Conservation, *Research and development, Water supply, Recreation, Flood control, Ponds, Drainage basin, Lakes, Rivers, Dams, Reservoirs, Streams, Fish, Managment.
Identifiers: *Ontario, *Conservation Authorities Act, Hydrometric records, Meteorogical records, Municipalities.

This article deals with the distinctive multiple purpose land and water resources district of Ontario as a device for carrying out a coherent set of programs drawing on several governmental departments. The operation of these districts dates from the 1964 Conservation Authorities Act, which permits local government to organize as an authority for purposes of flood control, fish and wildlife management, and any other scheme related to the conservation of natural resources within a drainage basin. In the case of water, hydrometric and meteorological records of the watershed are studied, as are flood records, reservoirs, lakes, ponds, and dams. After such study, assistance is requested by the Authority, from the government. Such aid may be economic or technical, but must be requested as a control measure on the Authority. The public is consulted, and a timetable of projects is presented, allowing for long-range modification as research and practice develop the plan. (See Vol 2, No 24, Field 6B, entry W69-09952). (Murphy-Rutgers)
W70-03022

LAND AND WATER DEVELOPMENT IN SOUTHERN FRANCE,
National Co. for the Management of the Lower Rhone and Languedoc Region.
For primary bibliographic entry see Field 03F.
W70-03023

ORGANIZATIONAL ADAPTATION TO CHANGE IN PUBLIC OBJECTIVES,
Colorado State Univ., Fort Colling. Dept. of Political Science.
D. Hill, P. O. Foss, and R. L. Meek.
Partial Completion Report, Colorado Natural Resources Center, June 30, 1969. 40 p, 24 tab, 1 fig. OWRR Project A-005-COLO.

Descriptors: *Organization adaptation, *Public objectives, *Water planning.

A case study of the Poudre River system in Colorado shows that generally, the organization for water distribution has maintained consistency of value perspective but have adopted their organizations forms, patterns of behavior, and communication linkages, to the requirements of changing system parameters. The development of the Poudre River Water Users Association is illustrative of a pattern of institutional innovation and cooperative activity by the organizations to maintain effective influence in a changing environment. There is an indication of intensification of demands by local water officials for a greater voice in the system. Given the patterns of perception by all actors in the system of the awareness, interest, and understanding of water matters by local water officials, it seems clear that the system will increasingly adapt to the values and objectives represented by these officials.
W70-03024

A PROGRAM IN URBAN HYDROLOGY. PART II: AN EVALUATION OF RAINFALL-RUNOFF MODELS FOR SMALL WATERSHEDS AND THE EFFECTS OF URBANIZATION ON RUNOFF,
Purdue Univ., Lafayette, Ind. School of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-03035

STATE ORGANIZATIONS FOR WATER RESOURCES PLANNING,
Daniel H. Hoggan.
Am Water Wks Ass'n J, vol 61, no 12, p 667-674, Dec 1969. 8 p, 1 ref.

Descriptors: *Water resources development, *Planning, *State governments, *Administrative agencies, River basin development, Federal project policy, Federal government, Administration, Conservation, Interstate commissions, Political aspects, Universities, Inter-agency cooperation, Wildlife conservation, Parks, Recreation, Financing, Legislation, California, New York, Minnesota, Texas, Utah.
Identifiers: *United States Water Resources Council.

A study was made of five state water planning agencies to determine the most efficient organizational structure for water resources planning and administration. This study analyzed the California Department of Water Resources, Minnesota State Planning Agency, New York Resources Water Commission, Texas Water Development Board, and the Utah Division of Water Resources. The study resulted in several recommendations as to the organization of a model water resources agency. Water resources development can best be managed by one state executive agency under a single chief executive. Related conservation areas such as wildlife, parks, and recreation should be combined under the same agency as water resources planning. The agency staff should be made up of specialists and be adequately equipped and financed. Special efforts should be made to coordinate executive and legislative programs. The expertise and research facilities of universities should be utilized. Requests of special interest groups should be considered in defining policy. The state should coordinate its water planning with the federal agencies, other states' agencies, and local organizations. Further recommendations are made as to the ideal structure of the agency staff. (Dearing-Fla)
W70-03039

COMPARATIVE COST EVALUATION OF DESALTED WATER SUPPLY VERSUS ALTERNATIVE FRESH WATER SUPPLY FROM A CONVENTIONAL SOURCE,
Texas Water Development Board, Austin. Planning Hydrology and Special Studies Div.
For primary bibliographic entry see Field 06C.
W70-03082

ECONOMIC MEASURE OF EFFECT OF EXTREME DATA,
Harvard Univ., Cambridge, Mass. Dept. of Engineering and Applied Physics.
Myron B. Fiering.
ASCE Proceedings, Journal of Sanitary Engineering Division, Vol 95, No SA4, Paper 6720, p 683-698, Aug 1969. 16 p, 8 fig, 6 tab, 6 ref.

Descriptors: *Data collections, *Sampling, *Statistical methods, *Cost-benefit analysis, Hydrograph analysis, Duration curves, Streamflow forecasting, Stochastic processes, Water yield, Water storage, Reservoir operation, Reservoir design, Water management (Applied).
Identifiers: *Extreme data analysis.

Hydrologic and sanitary engineers collect flow data with religious zeal, and practically no project is designed without a plaintive appeal for more data. Data collection agencies are concerned about the propriety, validity and utility of collecting more data everywhere, and have mounted systematic analyses of the cost and benefit associated with more observations. Techniques for evaluating the economic significance of extreme data are suggested; general guidelines, for selecting among competing design models which purport to be adequate to the task, are offered. Simulation and streamflow synthesis are used to derive performance indices from which conclusions can be reached in particular cases. The study does not make specific design recommendations. (Knapp-USGS)
W70-03091

WATER, EARTH AND MAN: 2. WORLD WATER INVENTORY AND CONTROL,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02E.
W70-03096

THE DISCOUNT RATE IN PUBLIC INVESTMENT EVALUATION.
Western Agricultural Economics Research Council, Denver, Colo.

Delworth B. Gardner, and Robert A. Young, Co-chairmen. Conference Proceedings, Committee on the Economics of Water Resources Development, Denver, Colo, Dec 17-18, 1968. 106 p, 23 tab, 2 fig, 9 articles.

Descriptors: *Discount rate, Evaluation.
Identifiers: *Public investment, *Social discount rate.

Discounting makes revenues and costs occuring in different planning intervals comparable in time. The explicit discount rate chosen will affect investment decisions in public and private resources. The publication is divided into two parts: The views from the Academy, and a panel discussion giving the views from the Federal Government. Four articles comprise the first part: On measuring the social opportunity cost of public funds; measuring the opportunity cost of private investment; the opportunity cost of displaced private spending and the social discount rate; and the discount rate in public investment evaluation. The second part is comprised of five statements by members of the Federal Government. (See also W70-03155 thru W70-03158). (Grossman-Rutgers)
W70-03154

ON MEASURING THE SOCIAL OPPORTUNITY COST OF PUBLIC FUNDS,
Chicago Univ., Ill.
Arnold C. Harberger.
Conf Proc, Comm on the Econ of Water Resources Develop, Denver, Colo, p 1-24, Dec 17-18, 1968. 24 p, 1 fig, 1 append, 4 ref.

Descriptors: *Discount rate, Interest rate, Time investment.
Identifiers: *Social discount rate, Opportunity costs.

In the basic model it is assumed that the social rate of time preference refers to an appropriately weighted average of the different marginal rates of time preference applicable to the individuals who compose society. A simple analytical framework which is sufficiently general to yield the market rate of interest, the private-sector marginal productivity of capital, and the social rate of time

preference as the appropriate rate of discount under special circumstances, is presented. The solution that emerges in the general case is equal to a weighted average of the last two or to the market interest rate adjusted for distortions in the capital market. An alternative formulation of the social opportunity cost of capital takes into account the external effects of Government borrowing. The implications of the analysis are discussed. (See W70-03154). (Grossman-Rutgers)
W70-03155

MEASURING THE OPPPRTUNITY COST OF PRIVATE INVESTMENT,
Institute for Defense Analyses, Arlington, Va.
J. A. Stockfisch.
Conf Proc, Comm on the Econ of Water Resources Develop, Denver, Colo, p 25-49, Dec 17-18, 1968. 25 p, 14 tab, 1 append, 9 ref.

Descriptors: *Discount rate, Interest rate, Investment, Inflation (Economic).
Identifiers: *Social discount rate, Opportunity costs.

The discount rate used to evaluate government programs should reflect the opportunity cost of private investment. The appropriate methodology to measure the opportunity cost of private investment is developed. What is needed is a measure of the marginal efficiency of private investment. Part I of the paper shows why yields of claims are inadequate measures of the opportunity cost of capital. A methodology is developed to measure the rate of return which utilizes the asset approach. Part II of the paper actually measures the rate of return. Part III of the paper presents a note on adjusting an empirically estimated or revealed rate of return for inflation. (See W70-03154). (Grossman-Rutgers)
W70-03156

THE OPPORTUNITY COST OF DISPLACED PRIVATE SPENDING AND THE SOCIAL DISCOUNT RATE,
Joint Committee on Economics (U.S. Congress).
Robert H. Haveman.
Conf Proc, Comm on the Econ of the Water Resources Develop, Denver, Colo, p 51-69, Dec 17-18, 1968. 19 p, 6 tab, 13 ref.

Descriptors: *Discount rate, *Investment, Interest rate.
Identifiers: *Social discount rate, *Opportunity costs.

This paper outlines the major contending arguments in the debate on the social discount rate concept and its empirical estimation: The social time preference position; the opportunity cost position, and the preferred opportunity cost position. Finally, an empirical estimate is made of the opportunity cost of displaced private spending using the empirical framework implicit in the preferred social interest position. This calculation is a grand-weighted-average of the opportunity costs of marginal public spending displaced by taxes. This position is the opportunity cost of public investments financed by the personal income tax. (See W70-03154). (Grossman-Rutgers)
W70-03157

THE DISCOUNT RATE IN PUBLIC INVESTMENT EVALUATION,
Howard Univ., Washington, D.C.
Stephen A. Marglin.
Conf Proc, Comm on the Econ of Water Resources Develop, Denver, Colo, p 71-82, Dec 17-18, 1968. 12 p, 16 ref.

Descriptors: *Discount rate, Interest rate, Investment, Competition.
Identifiers: *Social discount rate, Opportunity costs.

The case of perfect competition and Pareto optimality is examined. Such conditions lead to a market rate of interest is equal to the amount by which both the marginal rate of substitution of future for present consumption and the marginal rate of transformation between future and present consumption exceed unity. The following difficulties in the the theoretical identification of competitive equalibrium are examined: The open-endedness of the future, uncertainty, externalities (including public goods), increasing returns, risk-aversion, and income distribution. A discussion of the social rate of discount based on capital productivity (marginal rate of transformation) follows; last is a discussion of the social rate of discount based on the marginal rates of substitution. (See W70-03154). (Grossman-Rutgers)
W70-03158

A MULTIAGENCY DECISION MODEL FRAMEWORK FOR BENEFIT-COST ANALYSIS,
Waterloo Univ. (Ontario). Dept. of Management Sciences.
Donald J. Clough.
Canadian Oper Res Soc, Vol 7, No 3, p 193-203, Nov 1969. 11 p, 1 fig, 35 ref.

Descriptors: *Decision making, *Cost-benefit analysis, *Public benefits, *Water resource development, *Planning, Optimization, Joint cost, Professional societies, Political constraints.

The porblems of benefit-cost analysis of public works projects that arise when many different agencies enter into the decision-making process were discussed. Water resource planning projects in the Province of Ontario were discussed as examples in which government departments, political representatives, professional associations private groups, and public organizations directly or indirectly specified objectives and constraints. It was indicated that in principle each agency could have its own optimality criterion. However in the end, a decision to select a unique plan for implementation was usually based on political bargaining. If it turned out that all agencies selected the same optimal plan, the political problems were reduced. The bargaining processes in reaching agreement on a single plan on the basis of joint criterion function were not well understood or modelled. (Thiuri-Cornell)
W70-03163

TIME CAPACITY EXPANSION OF WASTE TREATMENT SYSTEMS,
Pennsylvania State Univ., University Park; and Stanford Univ., Calif.
For primary bibliographic entry see Field 05D.
W70-03167

CONTROL OF WATER QUALITY IN A COMPLEX NATURAL SYSTEM,
Clemson Univ., S.C. Dept. of Environmental Systems Engineering; and Georgia Inst. of Tech., Atlanta.
For primary bibliographic entry see Field 05B.
W70-03170

OHIO WATER COMMISSION.

Ohio Rev Code Ann secs 1525.01 thru 1525.04 (Page 1964), as amended, (Supp 1970), secs 1525.05, 1525.06, 1525.11 thru 1525.13 (Page Supp 1970).

Descriptors: *Ohio, *Water resources, *Water supply, *Flood control, Legislation, Legal aspects, Surface waters, Subsurface waters, Aquifers, Water utilization, Watersheds (Basins), Beneficial use, Hydroelectric power, Regulation, Administrative agencies, Water conservation, Water management (Applied), Data collections, Watercourses (Legal), Planning, Financing, Water quality, Water pollution, Bodies of water.

'Water resources' means all surface waters and all subsurface waters which are available or may be made available to agricultural, industrial, public, commercial, recreational and domestic users. 'Beneficial use' means a use of water that is reasonable and consistent with the public interest in the proper utilization of water resources. 'Water management' means planning, financing, or operating water improvements and programs. A Water Commission is created within the Department of Natural Resources to carry out the purposes of this section. In order to coordinate the water programs of the state, to develop water supply and flood control, and to obtain the most beneficial use of water resources, the Commission is authorized to: (1) recommend water development plans; (2) recommend water policy and legislation; (3) encourage the development of water resources; and (4) acquire and disperse hydrologic data. The factors which the Commission will consider prior to recommending loans for water management purposes are enumerated. The Commission will certify proposed water quality standards. The Water and Sewer Rotary Commission is created to handle applications for state funds to meet the cost of extending water and sewer lines for industrial purposes. (Keith-Florida)
W70-03212

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

OPPORTUNITY COST CALCULATIONS IN COST-BENEFIT ANALYSIS,
Nuffield Coll., Oxford (England).
Martin S. Feldstein.
Public Finance, Vol XIX, No 2, p 117-139, 1964. 23 p.

Descriptors: *Cost-benefit analysis, *Economic evaluation, *Investment, Financing, Value, Interest rate, Benefits, Capital, Debt, Taxes, Costs, Optimization, Budgeting.
Identifiers: *Public investment, *Opportunity costs, *S.O.C., *S.T.P., Rate of return, Social productivity, Target rates, Payback.

The social opportunity cost (SOC) of a public investment project is the value to society of the best alternative use to which the resources could have been put the SOC rates that have been suggested by others as measures of the opportunity cost of funds transferred from the private sector are inappropriate. An SOC rate can only be used as a measure of the social productivity of a private investment. The author shows that the SOC of funds transferred from other agency projects because of capital rationing cannot be evaluated by previously proposed methods. He also demonstrates that evaluating public investment projects in a mixed economy requires separate treatment of social time preference (STP) and SOC rates and that previously advocated methods for combining STP and SOC are inappropriate. Both the extent of government investment in water resource development and the wide-spread use of cost-benefit analysis, make this article useful to the water researcher. (Murphy-Rutgers)
W70-02985

SECOND-BEST RULES FOR PUBLIC ENTERPRISE PRICING,
Queen Mary Coll., London (England).
R. Rees.
Economica, Vol 35, No 139, p 260-273, Aug 1968. 14 p, 11 ref.

Descriptors: *Pricing, *Marginal costs, *Welfare, Prices, Efficiencies, Constraints, Monopoly, Taxes.
Identifiers: *Second-best, *Public enterprise pricing, Marginal cost pricing, Public sector, Private sector, Subsidies.

The case for marginal cost pricing by a public enterprise requires that prices equal marginal costs in the rest of the economy and it assumes that any resulting profit or loss is acceptable. In fact, the

requirement is not met and the assumption is invalid. There is often a close relationship between a public enterprise and private industries which do not sell at marginal cost. The basic principle is that public enterprise prices should be set so as to maximize welfare and achieve allocative efficiency. Any pricing rule which purports to be optimal in this sense and which is seriously proposed as a practicable basis for pricing must take into account the constraints which are likely to exist. These will in general involve departures from the conditions under which marginal cost pricing rules are derived and so we are in the domain of the 'second best.' Using some recent developments in the theory of the second best, the author attempts to examine the implications of the welfare maximization criterion when financial targets in the public sector and price/marginal-cost divergences in the private sector are taken into account. The constraint of the availability of information on which to calculate prices, and the costs of this information are ignored. Pricing policies for water supply involve questions of second-best solutions and this article may be relevant to the theoretical pricing problems of water. (Loeb-Rutgers)
W70-02988

TWO PROPOSITIONS ON THE OPTIMUM LEVEL OF PRODUCING COLLECTIVE GOODS,
Washington Univ., Seattle.
Yoram Barzel.
Public Choice, Vol 6, p 31-37, Spring 1969. 7 p, 3 fig, 1 append.

Descriptors: Demand, Costs, Governments, Economies of scale, Return.
Identifiers: *Optimality, *Collective goods, Homogeneous groups, Interpersonal comparisons, Subgrouping.

This paper discusses the problem of what is the optimal level of government for the production of collectively produced goods. Such a question is applicable to the water area in sectors such as water purification, anti-pollution measures and water supply. The paper is concerned with situations where economies of scale are not exhausted and where it is thus more costly to supply the service on a smaller scale, and with situations where segregation of consumers into homogeneous groups is not easy. The discussion of the first problem is basically at the individual level, and no interpersonal comparisons are necessary. The discussion of the second does involve such comparisons. (Loeb-Rutgers)
W70-02996

POSITIVISTIC MEASURES OF AGGREGATE SUPPLY ELASTICITIES: SOME NEW APPROACHES,
Oklahoma State Univ., Stillwater.
Luther G. Tweeten, and C. Leroy Quance.
AER, Vol 59, No 2, p 175-188, May 1969. 14 p, 4 tab, 14 ref, 3 disc.

Descriptors: *Elasticity of supply, Prices, Regression analysis.
Identifiers: *Positivistic measures, *Aggregate supply elasticities, Farm output, Direct least squares, Aggregate supply function.

Supply elasticities indicate the speed and magnitude of output adjustments in response to changes in product price. The authors are concerned in this paper basically with the elasticity parameter for aggregate farm output. Questions which the authors attempt to answer in this paper include: What is the magnitude of the elasticity of U S farm output with respect to price in the long and short run Is the elasticity increasing over time as the ratio of purchased to nonpurchased inputs increase. Are farmers less responsive to price decreases than to price increases as fixed asset theory implies. Three positivistic approaches are used to estimate the aggregate supply elasticity. The first is a direct least squares estimate of the aggregate supply function. Two additional disaggregate approaches which circumvent at least some problems of intercorrelation are also used to estimate the supply elasticity. These quantitative approaches may prove to be useful estimating the elasticities of supply in the water area as well. (Loeb-Rutgers)
W70-02997

BUDGET CONSTRAINTS: REDUCING THE ADMINISTRATOR'S FREEDOM,
Minnesota Univ., Minneapolis.
J. E. Jernberg.
Public Management Vol 51, No 8, p 10-13, Aug 1969. 4 p.

Descriptors: *Budgeting, *Decision-making, *Environment, *Technology, Taxes, Industries, Economics, Revenue, Education, Management, Community development.
Identifiers: *Budget constraints, *Community resources, Balanced budget, Appropriations, Expenditure accounting, Intergovernmental relationships.

The article considers the constraints on a budget-maker, past the normal establishment of categories for expenditure accounting control. Internal environmental constraints of the city's social and economic structure and characteristics are considered. Each community's characteristics determine its taxable resources and consequently affect managerial ability to fulfill community needs. Managerial willingness to fill these needs is another constraint, as is the decision-making of other governmental units. Reliance upon external revenue sources and related fiscal interdependence among levels of government is another important element that must be faced by the budget-maker, along with the obvious additional environmental factors. Since all of the problems cited are those faced in urban water resource planning, this article is of special interest to decision-makers in that field. (Murphy-Rutgers)
W70-03000

A COMPARISON OF DECISION CRITERIA FOR CAPITAL INVESTMENT DECISIONS,
State Univ. of New York, Buffalo.
C. C. Pegels.
Engineering Economist Vol 13, No 4, p 211-220, Summer 1968. 10 p, 3 tab, 6 ref, 1 append.

Descriptors: *Investment, *Capital, *Computers, *Input/output analysis, *Simulation analysis, Management, Planning, Time, Prices, Costs, Decision-making.
Identifiers: Output criteria, Cash flow, Probability, Common stocks, Rate of return, Decision criteria.

This article discusses the making of capital investment decisions. These decisions are based on one of several criteria. These are output criteria to aid selection from two or more investment proposals. This article reviews seven output criteria and compares them by simulating two hypothetical investment proposals on a digital computer. Although the computer results are not entirely conclusive as far as the investment decision is concerned, the simulation experiment demonstrates that investment proposals should be evaluated on the basis of several decision criteria rather than one preselected decision criteria. The method given is designed to facilitate and improve the quality of decision-making in capital investment problems. Since such decision-making is important in water resource projects, decision-makers in this field will find this article useful. (Murphy-Rutgers)
W70-03002

ECONOMICS OF LEAK SURVEYS,
Pitometer Associates, Pittsburgh, Pa.
Homer E. Beckwith.
American Water Works Association Journal, Vol 56, No 5, p 275-278, May 1964.

Descriptors: *Costs, *Leakage, *Economic efficiency, Statistics, Water transportation, Construction, Water treatment, Wells, Water rates, Water storage.
Identifiers: *Pumped water supplies, *Gravity water supplies, Capacity.

Water is considered free and the charges made are for the services of treatment and delivery. Due to the low costs, inefficiency is likely to be tolerated However, the aggregate costs of leaks in water transportation are likely to be sizable for the system as a whole. The distance which many cities must go for water, the increasing scarcity and the cost of treatment make this inefficiency intolerable. The author proposes increasing the metered rates as the most economically efficient way of obtaining additional water. The patented savings available in correcting leaks in both gravity supplies and pumped supplies is evaluated with the conclusion that the situation demands immediate correction. (Murphy-Rutgers)
W70-03006

COMPARATIVE COST EVALUATION OF DESALTED WATER SUPPLY VERSUS ALTERNATIVE FRESH WATER SUPPLY FROM A CONVENTIONAL SOURCE,
Texas Water Development Board, Austin. Planning Hydrology and Special Studies Div.
Donald E. Morris.
Paper presented at 50th Annual Meeting of American Geophysical Union, Wash, DC, Apr 24, 1969. 12 p, 5 fig.

Descriptors: *Cost analysis, *Desalination processes, *Water supply, *Texas, Saline water, Desalination plants, Brine disposal, Wells, Pipelines, Pumping plants, Fresh water, Water quality, Water chemistry, Economics.
Identifiers: Fresh water costs, Desalted water costs.

The cost of desalted water is generally higher than the cost of water from an alternative supply. The elements included in calculating the cost for desalting in Texas are: (1) well fields for saline feedwater supply; (2) intake system and pumping station; (3) pipelines; (4) pretreatment for saline water; (5) the desalting plant; and (6) brine disposal. The following elements were considered for calculating the cost of a conventional water supply: (1) raw water cost; (2) well field or intake system; (3) pipeline and required pumping stations; and (4) a conventional water treatment plant. Chemical water quality, secondary benefits, and project life are considered for final economic justification of a desalt project. Desalting is recommended as a practical interim solution for water supply problems in Texas. (Carstea-USGS)
W70-03082

A DECADE OF EXPERIENCE UNDER THE IOWA WATER PERMIT SYSTEM--PART ONE,
Iowa Univ., Iowa City.
N. William Hines.
Natural Resources Journal, Vol 7, No 4, p 499-554, Oct 1967. 5 tab, abt 140 ref.

Descriptors: *Iowa, Riparian rights, Administrative agencies, Beneficial use, Priorities, Administrative decisions, *Water permits.
Identifiers: *Permit system, *Iowa Water Permit Statute.

The article describes the Iowa permit system after its first ten years of existence. Part One includes Section I and Topic A of Section II. Section I examines riparian law in Iowa, reviews events leading up to enactment of the Iowa Water Permit Statute, examines the statute in detail, and compares present Iowa law to that of other jurisdictions. The statute has two main faults: it does not define any regulatory policy; and ideas drawn from various sources were never made consistent; some provisions actually contradict others. Similarities to western water law include employment of an allocation agency and utilization of the broad standard

of 'beneficial use.' Central difference are that Iowa accords no permanence of right and establishes no priority. Section II highlights issues faced in administering the permit system and describes in detail the endeavors of the Water Commission to resolve them. Topic A focuses on the issue of interpreting the scope of regulatory power. Decisions regarding vested rights, types of use to be regulated, amount of regulation to impose and the nature of rights granted by a permit are discussed. (See W70-03144). (Gossen-Chicago)
W70-03143

A DECADE OF EXPERIENCE UNDER THE IOWA WATER PERMIT SYSTEM--PART TWO,
Iowa Univ., Iowa City.
N. William Hines.
Natural Resources Journal, Vol 8, No 1, p 23-71, Jan 1968. 9 tab, 91 ref.

Descriptors: *Iowa, Administrative decisions, *Water permits, Priorities.
Identifiers: *Permit system, Processing applications, Permit transfer, Permit renewal, Permit modification, Permit termination, Permit suspension, Constitutionality.

The article describes the Iowa permit system after its first ten years of existence. Part Two includes: Topics B through E of Section II; Section III; and Conclusions. Section II highlights issues faced in administering the permit system and describes in detail the endeavors of the Water Commissioner to resolve them. Topic B describes the procedure for processing original applications. The application form, pre-hearing investigation, hearings, final determination, and appeal are discussed. Topic C focuses on the transfer of permits, D on renewal and modification, and E on termination and suspension. Section III reviews possible constitutional principles on which the Iowa Water Act might be challenged as deficient; substantive due process; procedural due process; and delegation of powers. The section on conclusions emphasizes the issue of priorities of use for times of scarcity. Iowa's policy of granting a permit for every beneficial use may be justified at present, but will require re-examination as demands increase. It is recommended that research be undertaken now to create standards for distinguishing among beneficial uses. (See W70-03143). (Gossen-Chicago)
W70-03144

RATES, REVENUES AND REALISM,
Coffin and Richardson, Inc., Boston, Mass.
John C. Adams, Jr.
Journal of the New England Water Works Association, Vol 83, No 3, p 191-209, Sept 1969. 19 p, 6 tab.

Descriptors: *Water rates, Income, Public utilities.
Identifiers: *Two-part rate, New England, Service charge plus a commodity charge.

The doctrine of water rates set by public and privately-owned water utilities is the doctrine of fair and equitable rates. This doctrine means rates which avoid undue or unjust discrimination among the various classes of customers. The water system must be capable of producing, transmitting, and distributing the quantity of water desired by each customer at any given time. To be fair and equitable, the utility's rates and charges should be designed to reflect the savings inherent in the uniform use of water at higher load factors and conversely to reflect the higher costs inherent in low factor customers. Utilization of a two part rate consisting of a service charge plus a commodity charge is recommended. Histories of water rates in New England and of two part rates are given. The allocation procedures of such a two part rate is explained. (Grossman-Rutgers)
W70-03153

A STUDY OF THE TECHNICAL AND ECONOMIC FEASIBILITY OF USING SEWAGE EFFLUENT FOR IRRIGATION IN LINCOLN PARISH, LOUISIANA,
Louisiana Polytechnic Inst., Ruston. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 03C.
W70-03159

WATER SUPPLY - SANITATION - DITCHES (FINANCING).

Ohio Rev Code Ann secs 6101.62-6101.64 (Page 1953).

Descriptors: *Ohio, *Water rates, *Public utilities, *Financing, Water works, Public utility districts, Legislation, State governments, Regulation, Legal aspects, Assessments, Administrative agencies, Sewage disposal, Sewers, Liquid wastes, Local governments, Cities.

A public corporation may appropriate the unappropriated funds of the corporation's water department to pay the annual levies or assessments by a conservancy district organized for the purpose of water supply. Only a certain percentage of the funds may be appropriated, and the rates to be charged by the public corporation for the water supplied are set. To retire interest and bonds and thus reduce the amount to be collected through an annual levy, the board of directors of a conservancy district may raise the water rates chargeable to a public corporation or person within the district. Ceiling rates are set as are guidelines for imposing such rates over a period of years. Increased rates shall be paid from water-works funds. Revenue from the increased rates is solely for the retirement of bonds. To pay assessments for the collection of sewage and liquid wastes, the public corporation may appropriate funds from the sewer fund derived from sewer rentals. (Barnett-Florida)
W70-03207

SANITARY DISTRICT BOARDS OF APPRAISERS.
Ohio Rev Code Ann secs 6115.29 thru 6115.44 (Page 1953), as amended, (Supp 1970).

Descriptors: *Ohio, *Appraisals, *Project planning, *Cost-benefit analysis, Legislation, Legal aspects, Reservoirs, Right-of-way, Easements, Damages, Planning, Eminent domain, Costs, Estimated costs, Benefits, Estimated benefits, Sewage, Sewage disposal, Water supply, Construction, Judicial decisions, Taxes, Assessments, Cost analysis, Value, Sewage districts.
Identifiers: Hearings, Settlements procedure.

Every sanitary district will have a board of appraisers consisting of three appraisers appointed by the court and recommended by the board of directors of the district. The board will appraise all property to be acquired for the works of the district. The board will also appraise all benefits and damages accruing to all lands within or without the district because of the execution of the official plan of the district. The board will have the assistance of the attorney, engineer and other employees of the board of directors in carrying out its function. In making appraisals, the board will consider only the effect of the execution of the official plan. After the board files its report with the court, notice thereof will be published. After publication of notice, the court will conduct hearings on exceptions taken to the report. If the court, after such hearings, concludes that the cost of implementation of the official plan is less than the resulting benefits, it will approve the board report. If the court finds the cost of implementation will exceed benefits, the court may disorganize the district or order the board of directors to prepare new plans. (Keith-Florida)
W70-03209

6D. Water Demand

MAJOR USES OF LAND AND WATER IN THE UNITED STATES WITH SPECIAL REFERENCE TO AGRICULTURE-SUMMARY FOR 1964,
Agricultural Research Service, Washington, D.C.
Thomas H. Frey, Orville E. Krouse, and Clifford Dickason.
Report avail for sale from Superintendent of Documents, US Government Printing Office, Wash, DC, 20402. Department of Agriculture, Economic Research Service Report No 149, 1968. 74 p, 14 fig, 31 tab, 19 ref, append.

Descriptors: *Water supply, *Water utilization, *United States, Consumptive use, Irrigation water, Land resources, Land use, Surveys, Data collections.
Identifiers: U.S. Land and Water use.

The 48-State annual renewable supply of 30 inches of average precipitation is equivalent to about 4.50 billion acre-ft, or 402 billion gpd over an average year. About 70% of the precipitation is consumed in place to support forest, range, and other vegetation, including nonirrigated farmland. The balance is runoff or streamflow, supporting such nonwithdrawal uses as power generation, waste dilution, navigation, and recreation. About 304 million acre-feet of streamflow and ground water were withdrawn for all purposes in 1965. Roughly 30% was consumed in the sense of not being available for withdrawal again. Agricultural irrigation accounted for 41.4% of all withdrawals but, because of a high rate of consumptive use (60%), represented 82.7% of the total consumption or net depletion. This consumption occurred on about 37.8 million acres of irrigated farmland in 1965, of which 34.9 million acres were concentrated in the western mainland regions or States. The national rate of increase in irrigated farmland is 1.85%. (Knapp-USGS)
W70-02891

RIVER MANAGEMENT.

Peter C G Isaac, ed. Alabama, University of Alabama Press, 1967. 258 p.

Descriptors: *Water quality, Water demand, River regulation, Rivers, Measurement, Computers, Telemetry, Water pollution, River flow, Discharge, Floods, Biochemical oxygen demand, Groundwater, Economics.
Identifiers: *River management, *Water quantity, Hydrological data, Fisheries, River control, Economic model.

The demand for water in England and Wales has steadily risen. As such, there is a growing need to develop more effectively the resources of rivers. The work of river authorities has emphasized the importance of river management. In the past, the various demands on the rivers have been under the jurisdiction of various bodies with different aims. Drainage has competed with water supply, and both have competed with angling and recreation. Criteria must be developed for reconciling these conflicting demands and it seems likely that such criteria must be economic in nature. Before such criteria can be developed, however, a number of technical factors must be brought into a common focus. For example, no real progress can be made until it is recognized that river-water quality is no less important than river-water quantity. The underlying theme of the symposium, whose papers are contained in this volume, was the control of the quantity and quality of river water so that it may be used to best effect for all its multifarious purposes. (Loeb-Rutgers)
W70-03015

LOS ANGELES CITY PROPER AND HARBOR MASTER PLAN FOR WATER SUPPLY,
Los Angeles City Dept. of Water and Power, Calif. Water Engineering Design Div.

Duane L. Georgson, Donald A. Trestik, John L. Graham, Toshio Fujimura, and E. S. Manirelli.
Report, City of Los Angeles Department of Water and Power, June 1966. 52 p, 16 fig, 8 tab.

Descriptors: *Water demand, *Water consumption, *Water supply, *Water conveyance, Aqueducts, Water distribution, Construction, Planning, Population, Forecasting, Urbanization, Construction costs, Project planning.
Identifiers: *Los Angeles, *Los Angeles harbor area.

The report presents a schedule of construction of water supply and distribution facilities required by the city of Los Angeles prior to the year 1990 to meet anticipated needs by the city proper and harbor area. The recommended $17.2 million construction program include a new water reservoir, reservoir modifications, new regulating stations, new water mains and trunk lines, and cement lining of some trunk lines. The study was made to permit prudent planning prior to design and construction in preparation for meeting the water needs of a population increasing at a rate of approximately 50,000 persons annually. It is estimated that the projected city population of 4,485,000 persons will use water at an average rate of 1,285 cfs in 1990, based upon 185 gallons per capita/day. This would be an increase of 66 per cent over the average 1963 consumption rate. Water system operating problems and needs anticipated in 1969 are also presented in the report in order to plan for utilization of water supplied by the Second Los Angeles Aqueduct beginning in late 1968. Proposed 1969 system operations, improvements and necessary adjustments to present facilities are described. (Poertner-Chicago)
W70-03147

EFFECTS OF NON-PRICE VARIABLES UPON PARTICIPATION IN WATER-ORIENTED OUTDOOR RECREATION: COMMENT,
Wisconsin Univ., Madison.
E. J. L. David.
American Journal of Agricultural Economics, Vol 51, No 4, p 942-945, Nov 1969. 4 p, 2 tab, 5 ref.

Descriptors: *Recreation, *Regression analysis, Average income age, Education, Occupations.
Identifiers: *Dummy variables, *Explained variation, *Intercorrelation.

This paper is a comment on a previous article by Gillespie and Brewer, ('Effects of Nonprice Variables Upon Participation in Water-Oriented Outdoor Recreation', Amer Jour of Agr Econ, Vol 50, p 82-90, Feb 1968). Three criticisms of the original article are: (1) the amount of explained variance reported, (2) the dependent variable, and (3) the handling of the intercorrelations. The problem of intercorrelations may be dealt with through the use of dummy variables of groups of the intercorrelated variables. The use of 'number of visits' as a dependent variable leads to unequal weights between different observations. The use of a grouped or dummy dependent variable may help to correct this problem. Such a dependent variable will increase the amount of explained variance reported. The parameters were re-estimated using dummy dependent and independent variables. (Grossman-Rutgers)
W70-03160

LEISURE MARKET STUDIES: I. Beach Users, II. Marina Development,
Rutgers - The State Univ., New Brunswick, N.J. Urban Studies Center.
George Sternlieb, Robert W. Burchell, James W. Hughes, and Paul A. Woodell.
Urban Studies Center, Rutgers University, Feb 1969. 161 p, 8 exhibit, 172 tab, 1 append, 3 map.

Descriptors: *Beaches, *Marinas, On-site data collections, Surveys, Financing.
Identifiers: *Beach users, *Marina development, *New Jersey shore.

This report studied the uses of the New Jersey shore through the use of surveys and questionnaires. The beach user survey covered the following areas: Beach attendance, problems of development as seen by shore entrepreneurs, age of structures (facilities), race observations, means of transportation to the beach town, length of total stay, total number of individuals, accommodations, occupations of beach users, and possible improvements. In the section on marina development the report attempted to isolate the variables which make for marina expansion. It is recommended that the state should intervene and that more mechanics are needed. The report also discusses the historical development of marinas, the problem of marina development, the operation of marinas, and various aspects of public marinas. A large appendix of data on beach users and marinas is included. (Grossman-Rutgers)
W70-03161

WATER TRANSPORT COSTS,
Binnie and Partners, London (England); and King's Coll., London (England). Dept. of Civil Engineering.
N. Paine, and J. K. White.
J Instut Water Eng, Vol 23, No 7, p 435-448, Oct 1969. 14 p, 3 fig, 2 tab, 3 append.

Descriptors: *Water transfer, *Water demand, *Mathematical models, *Optimization, *Cost-benefit analysis, Design, Pumping plants, Pipelines, Discount rate, Digital computers, Water distribution (Applied).

A method was described for the outline design, at minimum present value of the costs, of a pumping scheme to meet a growing demand for water transport within a typical range of unit costs and discount rates. A cost function model was developed for the optimum transport system which consisted of pumping stations, pumps, motors, control gear and pipes to illustrate the formulation of the cost as a function of all parameters. A digital computer was utilized for evaluating the minimum value of the costs for a representative range of stage lengths and pipe diameters. The affects of varying the system data, the pipe diameter and stage length were discussed. The solution for a typical scheme was given as an example. Simply staging both the station and the plant every 10 years yields a near optimum solution. Non-optimum pipe stages can lead to significant increases up to 13 per cent in total cost. (Thiuri-Cornell)
W70-03172

STORAGE YIELD: EXTENDING THE SEQUENT PEAK ALGORITHM TO MULTIPLE RESERVOIRS,
Water Resources Engineers, Inc., Springfield, Va.; and Texas Water Development Board, Austin.
G. K. Young, and C. D. Puentes.
Water Resources Res, Vol 5, No 5, p 1110-1114, Oct 1969. 5 p, 2 fig, 5 ref.

Descriptors: *Reservoir Design, *Storage capacity, *Multiple-purpose reservoir, *Time series analysis, *Water demand, *Systems analysis, Irrigation water, Municipal water, Industrial water, Timing.
Identifiers: Sequent peak algorithm.

The sequent peak algorithm was extended to find volume requirements as a function of time. The objective of the study was to present and demonstrate a technique for finding storage requirements in a multireservoir system. The technique evolved from a design situation having demands (irrigation municipal and industrial) increasing over time. The need for storage was found and placed in time at that point which was the latest time the storage could be built into the system and still be completely effective in carrying water forward to satisfy future droughts, within a minimum cost water development plan. The multireservoir systems storage yield relationships were three-dimensional, having time as the additional variable: aggregated design drafts versus time and required systems storage versus time. The technique was useful in determining reservoir construction timing in multiple reservoir systems. The principal variable used in the algorithm characterized a reservoir storage history which was unbounded by volume limits. (Thiuri-Cornell)
W70-03175

BENEFICIAL USE OF WATER IN A RIPARIAN JURISDICTION,
G. Graham Waite.
Wis L Rev, Vol 1969, No 3, p 864-883, 1969. 19 p, 88 ref.

Descriptors: *Wisconsin, *Indiana, *Riparian rights, *Water allocation, Administration, Competing uses, Distribution, Legal aspects, Water contracts, Water demand, Water policy, Water resources development, Water utilization, Alteration of flow, Diversion, Legislation, Relative rights, Beneficial use, Preferences (Water rights), Appropriation, Consumptive use.

Recognition of water as a limited resource leads to demands for regulating its use. New water uses must be developed within traditional riparian doctrines. This is an examination of problems of riparianism and possible methods for their solution through the application of administrative techniques to recognized riparian concepts. The diversion of water away from riparian owners presents constitutional questions. Regulation of water rights must avoid arbitrary distinctions between landowners and land uses. In Wisconsin, where water is being beneficially used, the riparian owner's consent is required for diversion; administrative control is limited to surplus waters. Some power over water use is centralized in the Department of Resource Development. Broad construction of the statute creating the Department might authorize a water use permit system. Indiana authorizes state purchase of water for public use. Problems of riparian rights along original and diverted watercourses are discussed. Surplus waters are exempted from riparian rights. This raises a question of deprivation of property that the riparian owner might later have used. Problems of uses of diverted water are discussed. The author concludes that authority for state water management may be inferred from legislation in Wisconsin and Indiana. (Dye-Florida)
W70-03177

6E. Water Law and Institutions

ENTRY UPON LAND TO PROTECT HIGHWAY FROM DAMAGE BY WATER.
N J Stat Ann secs 27:7-41, 27:7-49, (1966).

Descriptors: *New Jersey, *Highways, *Docks, *Bank erosion, Berms, Embankments, Roadbanks, Flood damage, Damages, Erosion control, Erosion, Bank protection, Piers, Jetties, Transportation, Condemnation, Right of way, Legal aspects, Transportation, Administrative agencies.

When deemed necessary, the Highway Commissioner may enter lands adjacent to state highways to reconstruct banks and structures necessary to preserve the highway. Such entry is neither trespass nor a taking for public use. The Highway Department may acquire land and water rights in any county of the sixth class and construct thereon structures, piers, wharves, or docks for the landing of boats for the carrying of freights, vehicles, and passengers. (Dye-Florida)
W70-02859

PROCEEDINGS TO ESTABLISH LANDINGS.
Miss Code Ann sec 7624 (1956).

Descriptors: *Mississippi, *Mississippi River, *Condemnation, *Public rights, Administrative agencies, State governments, Legislation, Navigable rivers, Inlets (Waterways), Bays, Bayous, Legal aspects, Public benefits, Land use, Riparian land, Docks.

Identifiers: *Boat landing.

Any three or more freeholders residing in a county bordering on the Mississippi River or other navigable river, bayou, bay, or inlet may petition the Board of Supervisors of such county to designate and set aside a parcel of land outside any municipal limits as a boat landing and cotton-yard for public use. The petition must identify the owner of the land proposed to be taken. The Board then shall determine whether such a landing is required for public convenience. If deemed necessary, the Board is to permit demarcation of a boat-landing site at a point most convenient for public use. (Barnett-Florida)
W70-02871

MISSISSIPPI WATER RIGHTS LAW,
Jack W. Pepper.
Am Water Works Ass'n J, Vol 50, No 8, p 997-1001, Aug 1958. 5 p, 3 ref.

Descriptors: *Mississippi, *Riparian rights, *Water rights, *Prior appropriation, Competing uses, Domestic water, Flood control, Industrial water, Irrigation water, Legislation, Municipal water, Obstruction to flow, Reasonable use, Riparian land, Riparian waters, Water pollution, Water law, Soil conservation, Dams, Drainage.

Despite an annual rainfall of almost sixty inches, increased industrial and irrigation demands have created the possibility of water shortages in Mississippi. Legislation created the Mississippi Water Resources Policy Commission to study this problem. The first laws adopted in Mississippi were based upon the riparian doctrine. Under this doctrine, the owner of land abutting a watercourse was entitled to use the water therein, undiminished in quantity and unimpaired in quality. The main fault with this doctrine is that it discouraged the full utilization of water resources. Even though modern courts adopted the principle of limiting riparian owners to reasonable use, non-riparians still had no right to the use of water from a watercourse. The Mississippi Water Rights Act of 1956 adopted the principle of water appropriation. This legislation, while declaring all natural surface water to be public water and subject to appropriation, recognizes numerous rights of riparian owners. The details of this legislation are outlined. Certain priorities are involved to insure an orderly development of surface waters. Other methods used to increase the available supply of water include prevention of waste and pollution and soil conservation practices to increase the groundwater recharge. (Schram-Florida)
W70-02897

THE LAW OF UNDERGROUND WATER; A HALF-CENTURY OF HUBER V MERKEL,
For primary bibliographic entry see Field 04B.
W70-02898

THE LAW OF UNDERGROUND WATER; A HALF-CENTURY OF HUBER V MERKEL (NON-STATUTORY RULES),
For primary bibliographic entry see Field 04A.
W70-02899

THE LAW OF UNDERGROUND WATER; A HALF-CENTURY OF HUBER V MERKEL (STATUTORY MATERIALS),
For primary bibliographic entry see Field 04B.
W70-02900

RECREATIONAL USE OF ENTIRE PRIVATE LAKE BY RIPARIAN PARTIAL BED OWNER.
Kan L Rev, Vol 9, No 1, p 91-94, Oct 1960. 4 p.

Descriptors: *Kansas, *Riparian rights, *Lake beds, *Boundaries (Property), Recreation, Riparian land, Severance, Civil law, Competing uses, Navigable waters, Non-navigable waters, Ownership of beds, Relative rights, Boating, Water sports, Fishing, Lakes, Recreation demand, Water utilization, Navigation, Judicial decisions, Reasonable use, Ponds, Beds, Beds under water, Social needs.
Identifiers: Artificial lakes.

In a recent suit, the riparian owner of a minor portion of a natural lake bed sought to enjoin adjoining owners who prevented him from using the entire lake by erecting physical barriers along their boundary lines. The Florida Supreme Court held that the plaintiff was entitled to a reasonable use of the entire lake for recreational purposes. The court adopted the civil law rule of reasonable use in common with other owners as best suited for Florida in view of the emphasis tourism places on water recreation. Many states cling to the common law view of absolute real property rights which grants to the bed owner exclusive dominion over overlying water. The civil law rule is making an inroad into the absolute concept because of the inconvenience of determining bed and surface boundaries and because of the growing utility the common right concept has for water recreation purposes. In Minnesota the civil law rule has been extended to a mere riparian owner regardless of bed ownership. These two concepts have also been extended in some states to private artificial lakes subject to recreational uses and having more than one riparian owner. (Douberley-Florida)
W70-02901

CONSTITUTIONAL LAW--NAVIGABLE WATERS--EXTENSION OF THE FEDERAL PEROGATIVE,
For primary bibliographic entry see Field 04A.
W70-02902

OWNERSHIP OF LAND UNDER NON-NAVIGABLE LAKE (DUVAL V THOMAS, 114 So 2d 791 (FLA 1959)),
J. Menalco Solis.
Tul L Rev, Vol 34, No 3, p 641-647, Apr 1960. 7 p, 51 ref.

Descriptors: *Civil law, *Ownership of beds, *Lake beds, *Riparian rights, Florida, Louisiana, Judicial decisions, Boundaries (Property), History, Non-navigable waters, Lakes, Water law, Legal aspects, Foreign countries, Barriers, Reasonable use, Water rights, Prescriptive rights, Relative rights, Riparian land, Usufructuary right, Access routes.
Identifiers: Common law rule.

A corner of plaintiff's land was covered by a segment of a non-navigable, land-locked lake. Abutting property owners had constructed fences which joined in the lake to cut off the plaintiff's access to the major portion of the lake. An injunction was granted to the plaintiff and the fences were ordered removed. The Supreme Court of Florida held that a land-locked, non-navigable lake may be used by all owners of property covered by the lake so long as that use does not unreasonably interfere with the rights of the other proprietors. In so ruling, the court adopted the civil law rule and rejected the common law rule that an owner is restricted to using only that area of a lake within the boundaries of his property. Criticizing this holding, the author traces the development of the civil law in several foreign countries and in the state of Louisiana, and concludes that no known doctrine of the civil law provides authority for the result reached. The rights of the abutting landowners to enclose their property, therefore, should be upheld. (Schram-Florida)
W70-02903

MICHIGAN, WISCONSIN, NEW ENGLAND AND NEW YORK (WATER RIGHTS LEGISLATION),
Lynn M. Miller.
Am Water Works Ass'n J, Vol 50, No 10, p 1277-1278, Oct 1958. 2 p.

Descriptors: *Water law, *Water rights, *Cities, *Riparian rights, Water storage, Recreation, Water supply, Natural flow doctrine, Competing uses, Industrial water, Municipal water, Irrigation water, Legislation, Prior appropriation, Dams, Public rights, Irrigation programs, Adoption of practices, Impounded waters, Recreation demand, Water policy, Reasonable use, Water resources, Great ponds, Watershed control, Water use.

A review of trends in water rights legislation reveals that particular water problems are not universal, but local. The areas affected, however, may be relatively large. The rapid expansion of large metropolitan areas has produced particular problems. In Wisconsin and Michigan the greatest impetus to study water rights has been provided by irrigation demands in agricultural areas contiguous to metropolitan areas. The present turmoil here is caused by the lack of statutory water laws. Exhaustive research and study are required before adequate legislation can distribute water rights between municipalities, agriculture, recreation, and industry. A 1957 Wisconsin legislative committee was set up to study these problems. Great conflict has developed over the proposal by agricultural interests to abandon the riparian-rights and public-use principles and substitute the priority allocation philosophy. Although various proposals have been made, the solution appears to lie in storing excess waters during periods of high precipitation. The most significant water rights question in New York and New England is the right of public access to streams and impounded waters for recreational purposes. In Maine, and perhaps many other places, a favorable position now exists towards the public as opposed to the controversial position of the appropriator. (Schram-Florida)
W70-02904

RIPARIAN RIGHTS--INLAND LAKES,
Arthur H. Toothman.
U Miami L Rev, Vol 14, No 4, p 689-692, Summer 1960. 4 p, 21 ref.

Descriptors: *Florida, *Boundaries (Property), *Riparian rights, *Ownership of beds, Judicial decisions, Water law, Non-navigable waters, Lakes, Lake beds, Recreation, Legal aspects, Relative rights, Remedies, Water rights, Competing uses, Prescriptive rights, Riparian land, Boundary disputes.

A corner of respondent's property lay underwater in a land-locked, non-navigable lake. The owners of the contiguous tracts erected barriers along the property lines which united at the submerged corner, rendering respondent's sector inadequate for recreational purposes. Respondent sought a mandatory injunction for the removal of the barriers. The Florida Supreme Court granted the injunction, holding that each owner was entitled to use of the entire lake provided that such use did not interfere with the concurrent rights of the other owners. Under the common law, non-tidal, non-navigable lake bottoms were susceptible of private ownership. The owner of a segment of a lake bed, however, was restricted to use of those waters overlying his land. A minority of jurisdictions in the United States have held that each lake bottom owner is entitled to the use of the entire lake. The court, acknowledging the majority view, utilized its judicial discretion to take into account social and economic customs and adopted the more liberal minority viewpoint but labeled it 'civil law.' Because the civil law is broader in scope than the common law theory of riparian rights, Florida will need a further decision to determine the extent of the civil law adopted in this case. (Schram-Florida)
W70-02905

RAILROAD FERRIES ON LAKE MICHIGAN; STREAMS, HIGHWAYS, RESTORED.
Wis Stat Ann secs 190.07, 190.08 (1957).

Descriptors: *Wisconsin, *Railroads, *Contracts, *Maintenance, Legislation, Legal aspects, Lake Michigan, Michigan, Transportation, Watercourses (Legal), Canals, Bayous, Rivers, Navigation, Shores, Construction.

Identifiers: *Restoration, Sloughs, Ferries.

Any Wisconsin railroad corporation may contract with the owner of any Michigan railroad which terminates on the eastern shore of Lake Michigan for the joint operation of their railroads. Corporations which operate railroads will restore or maintain every watercourse, road or canal adversely affected by the operation or construction of the railroad to such condition that its usefulness will not be materially impaired. Such railroad corporations may acquire any lands required to restore any watercourse, road, or canal. This section does not apply to sloughs or bayous closed by the government to aid the navigation of rivers. (Keith-Florida)
W70-02909

BOARD CONTROL OF REPAIR, CONSTRUCTION, AND IMPROVEMENT OF STREETS, SEWERS, SIDEWALKS, AND WATERCOURSES.

Wis Stat Ann sec 61.36 (1957), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Local governments, *Sewers, *Regulation, Watercourses (Legal), Storm drains, Legislation, Administrative agencies, Drains, Structures, Canals, Legal aspects, Highways, Road construction, Construction, Drainage, Drainage practices.

The village board may lay out, alter, extend, improve, repair, or discontinue any municipal roads, streets, alleys, sanitary and storm sewers, parks, and other public grounds. They may construct drains, canals, or sewers, and may alter, widen, or straighten watercourses. Their power extends to the building, alteration, repair, improvement, or discontinuance of any sidewalks and crosswalks as well as to the building and maintenance of roads and sidewalks required to connect the village with any transportation terminal or village property outside of its limits. (Barnett-Florida)
W70-02918

MISCELLANEOUS HIGHWAY PROVISIONS.
Wis Stat Ann secs 86.02, 86.022, 86.17 (1957).

Descriptors: *Wisconsin, *Highways, *Drainage systems, *Damages, Ditches, Lumber, Streams, Sluices, Legislation, Legal aspects, Local governments, Regulation, Tunneling, Maintenance, Transportation, Water supply, Water sources, Obstruction to flow.
Identifiers: Penalties (Civil).

Any person who injures a highway by obstructing it, by diverting a watercourse or sluiceway over it, or by any other act, will be liable in treble damages to the political division of the state charged with maintenance of the highway. Willfully obstructing traffic on a public highway by making any ditch or depression in, or by placing any obstruction on such highway is a misdemeanor. The placing of any obstruction in a ditch designed to drain a highway is also prohibited. The general public has the right to use and take water from any spring or creek which runs into or across the limits of any public highway. Such taking, however, must not interfere with the tunneling or piping of water for the purpose of draining or improving lands on either side of the highway. Any person wantonly interfering with the free use of such water shall be guilty of a misdemeanor, and shall be liable to any person injured thereby for all damages sustained. (Barnett-Florida)
W70-02919

WATERWAYS, BRIDGES AND DAMS USED FOR BRIDGES.

Wis Stat Ann secs 81.05, 81.38, 81.42 (1957), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Channels, *Highways, *Bridge construction, Bridges, Culverts, Administrative agencies, Boats, Navigation, Damages, Construction, Maintenance, Assessments, Costs, Taxes, Creasote, Lumber, Steel, Concrete, Cost sharing, Dams, Cities, Local governments, Transportation.
Identifiers: Navigability.

Town boards of towns with waterways suitable for general and useful navigation may adopt them as public waterways and expend highway funds to improve and maintain their navigability. Special appropriations are required for yearly expenditures in excess of $200.00. Towns are not liable for damages for defects in such waterways. Methods of cost sharing between towns and their counties for the construction and repair of bridges and culverts are described. When necessary, town boards may file petitions with the county highway committee for immediate construction or repairs. Structures shall be constructed of approved materials. Town boards may contract with private owners of dams for the use of such dams as bridges. (Duss-Florida)
W70-02920

HIGHWAYS, BRIDGES, DRAINS.

Wis Stat Ann secs 84.10-84.12, 84.14, 84.15 (1957), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Bridges, *Highways, *Administration, Bridge construction, Maintenance costs, Assessments, Cost sharing, Administrative decisions, Government, Insurance, Local governments, State governments, Cost repayment, Cost allocation, Administrative agencies.

The allocation of state funds for maintenance and operation of various types of bridges is provided. The State Highway Commission regulates the maintenance and operation of bridges. The Commission may acquire land and easements to be transferred to the federal government for the national parkway system. The eligibility of intrastate bridge projects for funds, procedure for initiating their construction, and the method of apportioning costs among counties and towns are provided. The Commission and the highway department of another state may determine details for bridges crossing state boundary waters. Costs for bridge construction are apportioned between states and benefitted counties within states. Interstate bridge construction is controlled jointly by the highway commissions of involved states. Such bridges become part of the state trunk highway system and are maintained toll-free after repayment of costs. Maintenance costs and Wisconsin's share of interstate bridges are obligations of the state. The state may insure bridges. (Dye-Florida)
W70-02921

LOCATION OF PIERS.
Pa Stat Ann tit 55, sec 281 (1964).

Descriptors: *Pennsylvania, *Piers, *Relocation, *Navigable waters, Locating, Legislation, Sites, Navigation, Navigable rivers, Coastal structures, Harbors, Coastal engineering, Engineering structures, Piles, Water policy, Legal aspects.

When any person has been authorized by act of assembly to build a pier in any of the rivers of the state, it is lawful to locate the pier as will best answer his purposes. Any change in the location of the pier is limited within a one hundred foot radius of the original location. In addition, any change of position cannot interfere with the navigation of the river or in any way injure private property. The direction and consent of the port wardens is required to construct a pier in any location where port wardens have been created by law. (Schram-Florida)
W70-02926

OBSTRUCTIONS IN HARBOR AND REMOVAL THEREOF.
Pa Stat Ann tit 55, secs 341-348 (1964).

Descriptors: *Pennsylvania, *Harbors, *Navigation, *Navigable rivers, Delaware River, Legislation, Administrative agencies, Wastes, Ships, Boats, Water pollution, Channels, Delaware River Basin Commission, Water law, Legal aspects, Jurisdiction.
Identifiers: *Obstructions to navigation.

After proper notice has been given, the owner of any canal boat, barge, or other vessel sunk in the channel of the Delaware of Schuylkill rivers within the limits of the Port of Philadelphia must remove such obstruction within ten days. Failure to comply subjects the owner to a one hundred dollar fine. In case of refusal or neglect to raise and remove sunken craft, the Harbor Commissioners shall have it removed at the expense of the owner. The removal expenses shall be a lien on the vessel and its cargo until paid. In case the penalty and expenses are not paid, the Commissioners may, after five days notice, sell the vessel and cargo at auction. If there is any deficiency, the President of the Commissioners may sue the owner for the amount of the deficiency. It is unlawful to cast any ballast, cinders, ashes, or any heavy article into the tide-way of the Delaware or Schuylkill rivers. There is a penalty of not more than one hundred dollars for every offense. (Schram-Florida)
W70-02927

FISHING LICENSES AND THE PENNSYLVANIA FISH COMMISSION.

Pa Stat Ann tit 30, secs 220-221.1, 229, 249, 250, 252-257, 265, 270, 290-293 (Supp 1969).

Descriptors: *Pennsylvania, *Permits, *Fish conservation, *Administrative agencies, Legislation, Legal aspects, State governments, Fish management, Fishing, Regulation, Control, Fish establishment, Fish reproduction, Fish hatcheries, Fish stocking, Leadership, Government finance, Capital, Fish, Fishing gear, Land tenure, Administration, Administrative costs, Administrative decisions, Wildlife conservation.

As related to fishing licenses, this act provides for: (1) the licensing of specified residents, nonresidents, nonresident aliens, and tourists; (2) license fees; (3) the appropriation of fees to the fish fund of the Pennsylvania Fish Commission; (4) exceptions from license requirements; and (5) complimentary licenses. The Pennsylvania Fish Commission is empowered to appoint assistant executive directors in charge of the Watercraft Safety Division and the Fish Management Division. The act also governs the following: (1) permission to fish for scientific and stocking purposes; (2) free distribution of fish from state fish hatcheries; (3) exclusive use of specified waters by children and disabled persons, and the planting of fish therein; (4) penalties for false representation in procuring fish; (5) which streams and lakes are to be open to the public for fishing; (6) the establishment by the Commission of nursery waters; (7) powers and duties of fish wardens; (8) Sunday fishing; (9) powers of officers to make arrests and destroy unlawful devices; (10) the establishment of a fish license fund and the purposes thereof; (11) the acquisition of lands by the Commission; and (12) donations to the Commission. (Marsee-Florida)
W70-02933

PORT AUTHORITIES IN COUNTIES OF SECOND CLASS.
Pa Stat Ann tit 55, secs 551, 553 (1964).

Descriptors: *Pennsylvania, *Port authorities, *Transportation, *Rivers, Harbors, Construction, Eminent domain, Legislation, Local governments, Legal aspects, Water resources development, Zoning, Taxes, Tax rate, Operating costs, Tariff, Maintenance, Maintenance costs, Operating costs, Highways.

The increased commerce and prosperity in second class counties require more effective coordination of transportation facilities, greater utilization of

rivers, and the development of port authorities. Thus, to promote the safety and welfare, a port authority shall be established in each second class county. It is intended that the authority cooperate with and/or acquire existing transportation facilities. Said authorities shall be empowered: (1) to acquire any necessary property or interest therein by purchase, lease, or otherwise, and to construct, improve, maintain, repair, and operate facilities; (2) to make by-laws and regulations for the management of their affairs; (3) to fix, alter, charge, and collect fares, rates, rentals, and other charges for its facilities by zones or otherwise to provide for the expenses of the facility; (4) to borrow money and issue negotiable notes and bonds; (5) to have the power of eminent domain; (6) to pledge or otherwise encumber any revenues of the authority; and (7) to establish carrier routes for the efficient operation of the transportation system. Private rights and property in the beds of existing public highways vacated for the purposes of the authority shall not be deemed destroyed or ousted by reason of such vacation. (Schram-Florida)
W70-02936

DOCKS AND WHARVES.
Pa Stat Ann tit 53, secs 16844-16848, 16852, 16854, 16858 (1957).

Descriptors: *Pennsylvania, *Docks, *Port authorities, *Surveys, Bridges, Piers, Piles, Legislation, Administrative agencies, Easements, Permits, Low water mark, Coastal structures, Delaware River, Local governments, Erection, Construction, Navigable rivers, Mapping, Channels, Boundaries (Property), Tidal waters.
Identifiers: Wharf lines.

A four thousand dollar fine is provided for extending or erecting any wharf into the tideway of the Delaware River contrary to this act. An application fee and license fee are authorized for the construction of any wharf on the Delaware or Schuylkill rivers. No district within Philadelphia County shall receive a license to erect such wharves without having filed a plan of the river front bordering such district. The jurisdiction of the Board of Wardens for the Port of Philadelphia is extended to include every navigable stream within Philadelphia County. When any person is licensed pursuant to this act to construct a wharf and said wharf would be erected where any fishing right or easement exists, the licensee may petition the county court. A plan for the establishment of wharf lines, showing the present low-water line, is outlined for Delaware County. After the survey of the Delaware River front is made and the low-water line established, trespassing upon said line shall be punishable by a fine of up to four thousand dollars. (Schram-Florida)
W70-02937

WIDEN, EXTEND OR RELOCATE HIGHWAYS.

Pa Stat Ann tit 53, sec 13802 (1957).

Descriptors: *Pennsylvania, *Highways, *Road construction, *Boundaries (Property), Highway relocation, Tunnels, Legislation, Conveyance structures, Bridges, Access routes, Roads, Streams, Interstate streams, Structures, Local governments, Interstate.

Any city of the first class may lay out, widen, extend, or relocate highways that connect with, or are approaches to, bridges or tunnels across streams forming the boundary between this and any other state. The council may also, at its discretion, construct viaducts or other structures or superstructures to carry such highways over other highways and property. Any such improvement, however, must substantially follow the course of the existing streets of the city which are in the most nearly direct continuous line with such bridge or tunnel. (Schram-Florida)
W70-02938

ACQUISITION OF PROPERTY.
Va Code Ann sec 33-255.5 (1953).

Descriptors: *Virginia, *Riparian land, *Eminent domain, *Beds under water, Riparian rights, Ownership of beds, Condemnation, Right-of-way, State governments, Legislation.

The State Highway Commission is empowered to acquire lands lying under water and riparian rights as necessary and convenient for any project. Property or property rights may also be acquired by condemnation or be eminent domain when necessary. (Douberley-Florida)
W70-02991

BRIDGE NOT TO OBSTRUCT NAVIGATION OR FISH.
Va Code Ann sec 33-216 (1953).

Descriptors: *Virginia, *Bridges, *Navigation, *Fish barriers, Bridge design, Navigable waters, Navigable rivers, Barriers, Fish passages, Engineering structures, Legislation.

Toll bridges authorized by this act must not be constructed so as to obstruct navigation or the passage of fish. (Douberley-Florida)
W70-03005

SILVER SPRINGS INC V THE CANAL AUTHORITY OF THE STATE OF FLORIDA (USE OF ADVICE FROM THE CORPS OF ENGINEERS).
226 So 2d 893-894 (I DCA Fla 1969).

Descriptors: *Florida, *Eminent domain, *Decision making, *Recreation, Judicial decisions, Condemnation, Condemnation value, Canals, Planning, Project planning, Coordination, Recreation facilities, Land use.
Identifiers: *Corps of Engineers.

Petitioner sought review by certiorari of an eminent domain proceeding on the grounds that the Canal Authority abused its discretion by allowing the Corps of Engineers to determine the quantity, location, and quantum of the lands to be acquired and the need of the lands for canal purposes. The court refused the writ, holding that the evidence supported the finding that the decision was the independent determination of the Authority. In view of the dominant and integral functions being performed by the Corps of Engineers, it was not an abdication of responsibility to rely heavily upon their expert advice and recommendations. It was alleged that one parcel was intended for recreational purposes only, a purpose which was held to be unauthorized under the statute in a prior decision, but the court found no basis for the contention. If any land was found to be acquired for recreational purposes, it was to have been excluded from the eminent domain proceedings by application to the trial court. (Douberley-Florida)
W70-03025

MUNICIPAL ELECTRIC ASSOCIATION OF MASSACHUSETTS V FEDERAL POWER COMM'N (REVIEW OF POWERPLANT LICENSE).

414 F2d 1206-1210 (DC 1969).

Descriptors: *Hydroelectric project licensing, *Standby power, *Water utilization, *Federal Power Act, Pumped storage, Federal project policy, Judicial decisions, Hydroelectric plants, Hydroelectric power, Powerplants, Electric power production, Water utilization, Engineering structures, Electric power demand, Electrical networks, Water distribution (Applied), Future planning (Projected), Project planning, Optimum development plans, Utilities, Non-consumptive use, Reservoirs.

Petitioners contested the awarding of a license by the Federal Power Commission to construct and operate a pumped storage hydroelectric power plant designed to provide power for periods of peak load. The court held that the Commission had not abused its discretion. Since a license to construct a power project authorizes the licensee to appropriate public water resources, the Commission must feel that the project is the highest and best use of the resource before the license may be granted. The court held that the urgent need for the project, the lack of feasible alternatives, and the proposals made for conservation and recreation justified the granting of the license. Although the project was not fitted into a comprehensive power plan for the area, the Commission was within its authority to approve the project. It was claimed that a larger facility was needed, but the Commission was held to be not unreasonable in authorizing the urgently needed smaller facility, since it could be easily expanded. (Douberley-Florida)
W70-03087

UNITED STATES V 959.68 ACRES OF LAND (ENHANCED VALUE THROUGH CHANGED PROJECT PLANS).
415 F2d 401-403 (3d Cir 1969).

Descriptors: *Condemnation value, *Appreciation, *Project life, Judicial decisions, Condemnation, Compensation, Economic impact, Value, Market value, Property values, Reservoirs, Planning, Project planning, Programs, Federal project policy, Reservoir sites, Riparian land, Land appraisal, Federal government.

Initial plans for a reservoir project indicated that only the lower portion of the land in question would be taken, but the plan was subsequently changed so that the remaining portion was included in the condemnation proceeding. The Government contested the fact that the amount paid for the upper portion reflected an enhanced evaluation because of its anticipated riparian status created by the project. In affirming the judgment, the court held that payment for the enhanced value was proper. The critical issue was whether it seemed probable when the project was announced and undertaken that it might be enlarged as to include the additional land. It was immaterial that the entire tract was condemned at once rather than acquired in separate portions, or that there was no reliance on the Government's assurances that the upper portion would not be needed. When land near a public project, but not indicated at the outset as probably to be included, is genuinely enhanced by the project, the Government, when it later determines to take these other lands, must pay their enhanced market value. (Douberley-Florida)
W70-03092

ILLINOIS WATER POLLUTION AND WATER RESOURCES COMMISSION, REPORT AND RECOMMENDATIONS TO GOVERNOR RICHARD B. OGILVIE AND THE 76TH ILLINOIS GENERAL ASSEMBLY.
Illinois State Water Pollution and Water Resources Commission, Chicago.
For primary bibliographic entry see Field 05G.
W70-03138

A DECADE OF EXPERIENCE UNDER THE IOWA WATER PERMIT SYSTEM--PART ONE,
Iowa Univ., Iowa City.
For primary bibliographic entry see Field 06C.
W70-03143

A DECADE OF EXPERIENCE UNDER THE IOWA WATER PERMIT SYSTEM--PART TWO,
Iowa Univ., Iowa City.
For primary bibliographic entry see Field 06C.
W70-03144

A REVIEW AND REVITALIZATION: CONCEPTS OF GROUNDWATER PRODUCTION

AND MANAGEMENT--THE CALIFORNIA EXPERIENCE,
University of Southern California, Los Angeles. School of Law.
For primary bibliographic entry see Field 04B.
W70-03145

URBAN STORM DRAINAGE CRITERIA MANUAL.
Wright-McLaughlin Engineers, Denver, Colo.
For primary bibliographic entry see Field 04A.
W70-03148

SUMMARY OF COLORADO DRAINAGE, (Chapter 2), AND PLANNING, (Chapter 3).
Wright-McLaughlin Engineers, Denver, Colo.
For primary bibliographic entry see Field 04A.
W70-03150

THE LEGAL FRAMEWORK OF THE ST LAWRENCE SEAWAY,
M. Cohen, and G. Nadeau.
U Ill L Forum, Vol 1959, No 1, p 29-50, Spring 1959. 22 p, 63 ref.

Descriptors: *St. Lawrence Seaway, *International Joint Commission, *Multiple-purpose projects, *International waters, St. Lawrence River, St. Lawrence Seaway Develop. Corp., Governments, Federal government, Rivers, Inland waterways, River flow, Regulated flow, Dam construction, Hydroelectric power, Hydroelectric plants, International commissions, Great Lakes, International law, Treaties, Locks, Engineering structures, Navigation, Boundary disputes, Cost sharing, Project planning.

The St. Lawrence Seaway has no overall agreement as its legal framework, but is an example of two nations accommodating their common interests in an international watercourse. Political, economic and legal problems were resolved after two generations of negotiations that resulted in a patchwork of international convention arrangements and municipal public law. The cooperative framework for the separate development of power and navigation projects was based on a simple exchange of notes, passage of parallel legislation by each country, and an order of approval from the International Joint Commission (IJC). The Boundary Waters Treaty between the United States and Canada was designed to solve potential problems with relation to boundary waters and rivers running along the boundary. The Treaty established the IJC with judicial, investigative and administrative functions, and its order of approval was the most important basis of cooperation. It provided general rules and created machinery for managing common interests in the waterway construction and in regulating flow levels. Statutes passed by each country deal with liability for damages, and the order of approval allocates costs. Cooperation between the corporations set up by each country to construct the Seaway took the place of a unified authority. (Douberley-Florida)
W70-03178

AUTHORIZATION TO ACQUIRE LAND FOR INDUSTRIAL PURPOSES AND FOR PORT AND TERMINAL FACILITIES.
Miss Code Ann sec 7549.7-01 (1956), sec 7557.8 (Supp 1968).

Descriptors: *Mississippi, *Harbors, *Port authorities, *Land reclamation, Land development, Legislation, Administrative agencies, Local governments, Rivers, Bays, Lakes, Boundaries (Property), High water mark, Ownership of beds, Storage, Regulation, Dredging, Land forming, Landfills, Tidal waters, Land tenure, Cities, Land resources, Land use, Legal aspects.

The port commissions of Mississippi have jurisdiction over all land which is now, or was at one time, below the mean high tide mark of any river, bay, or natural lake. This jurisdiction extends to lands adjacent to ports and harbors as well as to lands acquired by lease, purchase, or eminent domain from individuals or corporations by the city or port commission. The commission is authorized to reclaim such lands by filling, dredging, or other means, and to utilize, lease, or dispose of these lands for the development and operation of the port. Any city or county, or both, may acquire or sell land situated in such county, whether within the city limits or not, for industrial purposes or for port, terminal, landing, and storage facilities. For this purpose, the cities and/or counties are empowered to borrow money and issue bonds, notes, or certificates as security. Land bought by a city, or cities, whether alone or jointly with a county, may not be located more than seven miles from the city's corporate boundaries. (Barnett-Florida)
W70-03182

IMPROVING RAILROADS AND CANALS.
Pa Stat Ann tit 15, secs 4071, 4081 (1967).

Descriptors: *Pennsylvania, *Canals, *Railroads, *Structures, Docks, Bridges, Piers, Streams, Rivers, Navigation, Navigable waters, Navigable rivers, Transportation, Aqueducts, Stream improvement, Riparian rights, Diversion, Right-of-way, Channel improvement, Cities, Legislation, Legal aspects.
Identifiers: Obstruction to navigation.

Railroad companies may erect docks, wharves and piers in any navigable stream where necessary for public and business purposes. Any such railroad company may also take and hold lands, wharves, docks or piers provided that the navigation in streams or rivers shall not be impeded by said railroad structures. Structures in Philadelphia are restricted by rules applying to that city. For the purpose of securing the safety of property and persons and increasing transportation, any railroad, canal or slack-water navigation company may straighten, widen, deepen, enlarge or otherwise improve their lines of railroads, canals, and slack-water navigation and the bridges, crossings, aqueducts, piers and structures thereof. For the above purposes railroad and navigation companies may purchase, hold, and use, or enter upon and appropriate lands and materials and use of lands for the flow of water diverted by any structure or embankment. (Smith-Florida)
W70-03184

ACCESS TO CANALS AND NAVIGABLE STREAMS.

Pa Stat Ann tit 15, secs 4320, 4321, 4324, 4325 (1967), as amended, (Supp 1969).

Descriptors: *Pennsylvania, *Railroads, *Streams, *Canals, Right-of-way, Transportation, Navigable waters, Navigable rivers, Riparian rights, Access routes, Roads, Mining, Coal mines, Economics, Occupations, Legislation, Legal aspects.

When the owners of any railroad possess the landing where the railroad joins a canal or other navigation, and any lateral railroad is constructed to connect with said railroad for the purpose of using the landing for trade, and the owners of the landing refuse to permit the trade of said lateral railroad, then the county court shall determine the proper fee for an appropriate portion of the landing and shall direct the landing to be open to the public. The users of lateral railroads may procure landings or wharves. Certain wharf owners are exempt from these provisions. This act shall apply to all navigable streams in Armstrong County. It shall be lawful for owners or lessees of iron ore or coal mines to construct lateral railroads from said mines to any railroad, public road, or navigable stream, over or under any intervening lands, provided that no existing mine or county line shall be crossed. These sections were repealed by section 2204 (i) of Title 15 insofar as they relate to business corporations and foreign business corporations. (Smith-Florida)
W70-03185

WIDTH AND LOCATION OF PIER HEADS.
Pa Stat Ann tit 53, sec 16866 (1957).

Descriptors: *Pennsylvania, *Piers, *Rivers, *Specifications, Abutments, Coastal structures, Piles (Foundations), Docks, Quality control, Cities, Regulation.

All pier heads hereafter intended to be sunk in the river beyond Wharf Street shall be of a certain stated width and located at a stated distance from the street. The pier shall be composed of good, square timber, well fitted and secure. (Smith-Florida)
W70-03186

NATIONAL FORESTS IN PENNSYLVANIA.
Pa Stat Ann tit 32, sec 101 (1967).

Descriptors: *Pennsylvania, *National forests, *Jurisdiction, *Federal government, United States, Water resources development, Federal jurisdiction, State jurisdiction, Federal reservations, Forests, Public lands, Conservation, Condemnation, Administration, Administrative agencies, Legislation, Legal aspects, River basin development, Navigation, Watersheds (Basins), Watershed management, River basin commissions, Navigable rivers, Navigable waters, Streams, Rivers, River basins.

The United States is empowered to acquire by purchase or condemnation such lands in Pennsylvania as may be needed to establish National Forest Reserves. Such power is granted in accordance with an act of Congress enabling any state to cooperate with any other state or with the United States for the protection of watersheds of navigable streams and which provides for the appointment of a commission to acquire lands for conserving the navigability of navigable rivers. (Smith-Florida)
W70-03188

POWER AND SUPPLY PERMITS.
Pa Stat Ann tit 32, secs 592-595, 598 (1967).

Descriptors: *Pennsylvania, *Hydroelectric plants, *Dam construction, *Permits, Federal government, Navigable waters, Legislation, Legal aspects, Administration, Management, State governments, Alteration of flow, Obstruction to flow, Electric power production, Hydroelectric project licensing, Islands, Steam, United States, Federal jurisdiction, Administrative agencies, Powerplants, Dams.

Any power dam or change in stream to develop power on navigable waters or affecting the interests of interstate or foreign commerce is within the jurisdiction of the United States. Permits for construction of power dams not within the United States' jurisdiction are valid for fifty years. Permits for the construction of dams on waters within the jurisdiction of the United States are issued by the Water and Power Resources Board, subject to subsequent licensing by the Federal Power Commission. Permits are subject to an annual charge to pay the cost of administering this act. A permit is required in order to use any dam to develop water power for the generation of electric energy for use in public service. Any permittee may, with the consent of the Board, submerge, occupy, use, and overflow any island owned by the Commonwealth appurtenant to the power project. The provisions of this act in relation to production of steam power within the jurisdiction of the United States are suspended until the Federal Power Commission requires licenses for such projects. The Attorney General may institute proceedings to revoke a permit for violations of these provisions. (Barnett-Florida)
W70-03190

FISHING WITH NETS AND SET LINES.
Wis Stat Ann secs 29.30, 29.33, 29.336, 29.34, 29.343, 29.35, 29.36, 29.37 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Permits, *Commercial fishing, *Fish, Wildlife, Gars, Rough fish, Fish conservation, Legislation, Regulation, State governments, Nets, Fyke nets, Gill nets, Fishing gear, Boats, Administrative agencies, Inspection, Inland waterways, Mississippi River, Rivers, Legal aspects, Control.
Identifiers: Licensing.

Restrictions concerning the use of nets and set lines for catching game fish are set forth. Minimum requirements as to size and type, and as to time limitations for the use of certain nets are stipulated. Licenses are required for the use of nets and set lines. Noncompliance with the provisions of this act may cause the license to be revoked or cancelled. Licenses must be procured for commercial fishing in outlying waters. Fees will be assessed for the licenses depending upon the applicant's residency and upon the size of his boat. Special licenses are required for fishing with special equipment for designated species of fish. A license is required to use set or bank poles in inland waterways. The use of set lines must be licensed by the Conservation Commission. The Commission may request reports from any licensees concerning the amounts and kinds of fish caught with set lines. (Barnett-Florida)
W70-03193

FISH HATCHERIES AND FISH PROPAGATION.

Wis Stat Ann secs 29.50, 29.51, 29.513, 29.515, 29.52, 29.53, 29.535, 29.536 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Fish hatcheries, *Fish reproduction, *Fish conservation, Legislation, Legal aspects, Ponds, Fish stocking, Permits, Rough fish, Fish barriers, Navigable waters, Beds, Public rights, Water supply, Cities, Mississippi River, Navigation, Regulation, Fish, Fish eggs, Fish management, Administrative agencies.
Identifiers: *Game fish, Trespass, Penalties (Criminal).

The State Conservation Commission is given general charge of the propagation and breeding of fish, the diffusion of useful information relative thereto, and the general management of the state fish hatcheries. No person may remove fish or fish eggs from the state unless he has been issued a permit by the Commission. The Commission may erect barriers to exclude rough fish from the waters of the state provided such barriers will not unreasonably interfere with navigation. Any person owning all of the land bordering on a landlocked navigable lake may apply to the Commission for a permit to remove, destroy, or introduce fish into such lake. Trespassing on state fish hatcheries is a criminal offense. The Commission will issue permits for private fish hatcheries to any owner or lessee of lands suitable for propagating fish. Owners and lessees of particular types of land may, with Commission approval, operate private hatcheries for the purpose of propagating rough fish. To lawfully import fish into the state for stocking purposes, one must obtain a permit from the Commission. Cities may operate fish hatcheries after obtaining permission from the Commission. (Keith-Florida)
W70-03194

HARBORS AND NAVIGATION.

Wis Stat Ann secs 30.12, 30.13, 30.15, 30.16, 30.17 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Permits, *Riparian rights, *Structures, Resource development, Legislation, Legal aspects, Administrative agencies, Regulation, Jurisdiction, Piers, Buoys, Docks, Navigable waters, Beds, Bulkhead line, Navigation, Streams, Obstruction to flow, Recreation, Public rights, Rivers, Canals, Harbors, Construction, Riparian land.
Identifiers: *Riparian owners, *Obstructions to navigation, Pierhead line, Penalties (Criminal).

In the absence of legislative authorization or a permit granted by the Department of Resource Development, it is unlawful to deposit any material or place any structure on the bed of any navigable water where no bulkhead line has been established or beyond a lawfully established bulkhead line. Under certain conditions the Department may grant any riparian owner a permit to build for his own use a structure otherwise prohibited by statute. A permit may likewise be granted to enable a riparian owner to place a layer of sand on a bed adjacent to his property for recreational improvement. Riparian owners may build piers without a permit provided the piers do not interfere with public rights or rights of other riparian owners. Such piers are subject to any established pierhead line. Various types of obstructions to navigation are made unlawful and certain exceptions are noted. Certain governmental units are given authority to remove obstructions to navigation under specified conditions. It is made unlawful to intentionally remove or moor to a government buoy or beacon. (Keith-Florida)
W70-03196

NAVIGABLE WATERS, HARBORS, AND NAVIGATION.

Wis Stat Ann secs 30.20-30.25 (1964), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Beds, *Water resources development, *Interstate compacts, Legislation, Legal aspects, Navigable waters, Public rights, Cities, Regulation, Water levels, Recreation, Riparian land, Zoning, Federal government, Public utilities, Permits, Dams, Great Lakes, Structures, Water supply, Sewage treatment, Sewage disposal, Navigation, Water pollution control, St. Lawrence Seaway, Harbors.
Identifiers: *Great Lakes Basin Compact, Penalties (Criminal).

A contract from the Department of Resource Development is required in order to remove any material from the beds of navigable lakes or outlying waters. The conditions under which the Department is authorized to grant such contracts are specified. When any lake area becomes unfit for recreational use, the Department may establish zones within which riparian owners may remove material from the lake bed to restore the area to recreational use. Public utilities acting pursuant to municipal permits may construct such structures on beds as are necessary to secure an adequate water supply to the utility, improve navigation or harbor facilities, or generate electricity. Provision is made for the Governor to appoint commissioners to the Wisconsin Great Lakes Compact Commission. It is the duty of the Commissioners to represent the state on the Great Lakes Commission and work for the development of the St. Lawrence Seaway. It is the policy of the state to aid in the accomplishment of the purposes of the Great Lakes Basin Compact. The state accepts the transfer of federal project structures and property on the Upper Fox River. No effort will be made to improve specified portions of the Wolf River. (Keith-Florida)
W70-03198

WATER, ICE, SEWAGE AND REFUSE.
For primary bibliographic entry see Field 05G.
W70-03199

MUNICIPAL CORPORATIONS.

Ohio Rev Code Ann sec 727.01 (Page 1953), as amended, (Supp 1970).

Descriptors: *Ohio, *Assessments, *Cities, *Public utilities, Legislation, Local governments, Costs, Projects, Project benefits, Cost allocation, City planning, Administration, Construction costs, Maintenance costs, Piers, Water storage, Sewers, Drains, Streams, Levees, Structures, Reservoirs, Treatment facilities, Channel improvement.

The legislative authority of a municipal corporation may assess upon the benefitted land a portion of the cost of constructing or improving docks, wharves, piers, sewers, sewage disposal and treatment plants, water treatment plants, reservoirs, water storage tanks, or any other utility works. No part of the cost connected with changing or improving any stream or watercourse, or for constructing or improving any levees or boulevards shall be levied against any land being used solely for off-street parking or solely for single or two family dwellings. (Powell-Florida)
W70-03205

PUBLIC PARKS AND RECREATION.
Ohio Rev Code Ann secs 1541.06, 1541.07, 1541.10, 1541.17, 1541.18, (Page 1964), as amended, (Supp 1970).

Descriptors: *Ohio, *Parks, *Boating, *Interstate compacts, Legislation, Legal aspects, Bodies of water, Recreation, Fishing, Lakes, Reservoirs, Inspection, Canals, Permits, Safety, Boats, Pennsylvania, Water resources, Dams, Swamps, Water supply, Water conservation, Flood control, Jurisdiction, Water pollution.
Identifiers: *Pymatuning Lake, Penalties (Criminal).

Certain named bodies of water and lands are dedicated and set apart forever for the use of the public as public parks; the lakes named will be open at all times to the public as resorts for recreation and pleasure, including hunting, fishing, and boating. Park officers will have the authority vested by law in constables to keep the peace in public parks, to enforce park regulations, and to make arrests when necessary. Park officers will inspect all boats and watercraft operated upon the waters of any state reservoir, lake, or canal; if such craft are found unsafe, the officer will prohibit further use of the craft and may impound them to enforce this section. (Keith-Florida)
W70-03213

CANAL LANDS.

Ohio Rev Code Ann secs 1545.29, 1545.30 (Page 1964).

Descriptors: *Ohio, *Leases, *Canals, *Parks, Legislation, Legal aspects, Income, Contracts, Administrative agencies, Recreation, Recreation facilities, Bodies of water, Water supply, Natural resources, Hydroelectric power, Land use, Land tenure.

State canal lands which have been abandoned for canal use may be leased to any park district by the agency in control of such canal lands. The park districts may sublease these canal lands and waters. The leasing district will insure by the terms of its lease that it may make such improvements on the leased land as will fit the land for public park and recreational uses. This section does not apply to canal lands, land, and bodies of water used or to be used for power, water supply, or other industrial purposes. (Keith-Florida)
W70-03214

MUNICIPAL CORPORATIONS.
Ohio Rev Code Ann sec 723.51 (Page 1953).

Descriptors: *Ohio, *Cities, *Streams, *Highway relocation, Routing, Legislation, Local governments, Projects, City planning, Construction, Diversion, Streamflow, Highways, Dams, Aqueducts, Drains, Cisterns, Sewers, Sewage disposal water works, Wells, Pumps, Reservoir sites, Reservoirs.

Any municipal corporation may relocate a road or stream if necessary in the construction of wells, pumps, cisterns, aqueducts, water pipes, dams, reservoirs, reservoir sites, sewers, drains, sewage disposal or water purification plants or water works. (Powell-Florida)
W70-03216

POWERS OF TOWNSHIP TRUSTEES.
Ohio Rev Code Ann secs 505.13, 505.26, 505.46 (Page 1953), as amended, (Supp 1970).

Descriptors: *Ohio, *Local governments, *Boats, *Bridges, Bridge construction, Islands, Taxes, Government finance, Operating costs, Road construction, Construction material, Streams, Rivers, Schools (Education).
Identifiers: *Footbridges.

The board of trustees of any township which is composed in whole or in part of islands accessible from the mainland only by watercraft may levy a property tax to purchase and operate a scow or lighter large enough to carry road building materials. Any board of township trustees may provide for and maintain bridges over its streams. The board may also construct and maintain footbridges over rivers and streams to provide school children convenient access to the public schools. The cost of such footbridges shall not exceed one thousand dollars apiece. (Dearing-Florida)
W70-03217

ATTORNEY GENERAL LEGAL ADVISER IN CANAL LAND DISPUTES.

Ohio Rev Code Ann sec 109.11 (Page 1969).

Descriptors: *Ohio, *Canals, *Administrative agencies, *Land tenure, Legal aspects, Surveys, Contracts.

The Attorney General and his assistants shall be the legal advisors of the Department of Public Works and all other state departments in disputes concerning canals, canal basins, and canal lands. He shall examine and perfect title to same. He may contract with surveyors and title examiners in examining and perfecting title in these lands. He shall submit quarterly reports to the Natural Resources Commission and the Legislative Service Commission. (Dearing-Florida)
W70-03218

REGULATION OF THE TAKING OF CERTAIN FISH FROM THE PUBLIC WATERS OF RHODE ISLAND.
R I Gen Laws Ann 20-14-1 thru 20-14-5, 20-15-1 (1968).

Descriptors: *Rhode Island, *Striped bass, *Fish, *Atlantic menhaden, Legislation, Commercial fishing, Fish management, Nets, Seines, Trapping, Interstate, Bays, Inlets, Permits, Atlantic Ocean, Size, Fishing, Natural resources, Water resources.

No person, firm or corporation shall take from the public waters of this state any striped bass measuring less than sixteen inches in length. The use of a net, seine, or any other contrivance is prohibited in the taking of striped bass; a hook and line, spear, or authorized fish traps may be used. This chapter does not apply to fish being transported in unbroken packages originating outside, and destined beyond this state's limits. Fines and suspension of fish trap licenses may be imposed upon violators of this act. It is unlawful for anyone to take with purse net or seine any fish commonly known as menhaden, provided that residents and certain Rhode Island corporations may obtain annual licenses to take menhaden. (Casey-Florida)
W70-03220

COOPERATION IN FEDERAL PROJECTS.
R I Gen Laws Ann secs 20-2-1 thru 20-2-5 (1968).

Descriptors: *Rhode Island, *Fish management, *Wildlife management, *Administrative agencies, Wildlife, Legislation, Legal aspects, Federal government, Projects, Conservation, Natural resources, United States, Inter-agency cooperation, Regulation, Planning, Programs, Financing.

The United States Fish and Wildlife Service of the Department of the Interior is authorized to conduct fish-cultural work in state waters, and Rhode Island assents to the conduct and establishment of wildlife restoration, fish restoration and management projects as defined by, and in compliance with, federal statutes and regulations. The Division of Conservation, with the approval of the Director of Natural Resources, is authorized and directed to conduct and establish cooperative programs in these areas. Provisions for appropriations and disbursements of state funds are provided. (Casey-Florida)
W70-03224

6F. Nonstructural Alternatives

THE FLOOD CONTROL CONTROVERSY, BIG-DAMS, LITTLE DAMS, AND LAND MANAGEMENT,
For primary bibliographic entry see Field 04A.
W70-03013

HAZARD AND CHOICE PERCEPTION IN FLOOD PLAIN MANAGEMENT,
Chicago Univ., Ill.
Robert W. Kates.
Chicago, Illinois, University of Chicago, 1962. 157 p.

Descriptors: *Floods, *Decision-making, *Nonstructural alternatives, Flood control, Flood damage, Resource management, Flood plains, Economic evaluation, Risks, Planning, Flood protection, Population, Probability, Costs, Economic justification, Regional flood.
Identifiers: *La Follette, Tennessee, *Hazard evaluation, Information availability.

The first chapter of this book is devoted to a restatement of the paradox of greater flood control and increasing flood damages and the alternatives for flood damage reduction. The second chapter is of primary importance to the student of resource management and deals with the relevancy of decision theory and decision-making schema to resource management, particularly flood plains and the reasons for their occupation. The following chapter presents the results of the study performed on the flood problems of La Follette, Tennessee and the decisions of the people of that area along with reconnaissance studies in six other areas. Following this, the type of information available to these areas and its effect on flood control is discussed. The theoretical range of choice perceived by the people is evaluated. The book concludes with a discussion of the role in flood damage reduction played by the decision-making process and the information available to managers. (Murphy-Rutgers)
W70-03017

6G. Ecologic Impact of Water Development

RESOURCES IN AMERICA'S FUTURE,
Hans H. Landsberg, Leonard L. Fischman, and Joseph L. Fisher.
Baltimore, Maryland, The Johns Hopkins Press, 1963. 1017 p.

Descriptors: *Natural resources, *Demand, *Supply, *Recreation, *Water resources, Land, Mineralogy, Population, Industrial production, Income, Management, Expenditures, Investment, Foods, Textiles, Construction, Transportation, Heat, Crops, Lumber, Metals, Energy.
Identifiers: Labor force, Public policy, Price systems, Clothing, Durable goods, Containers, Packaging, Paper products, Military goods, Woodpulp, Mineral fuels, Nonfuel materials

One of the great questions before any nation concerns the adequacy of natural resources to provide the kind of living its people desire. Even in the United States, with large resources of land, water, energy, and minerals, one finds concern regarding the over-all adequacy of resources to support the rate of growth of the economy. The core of this book is the projections of demand and supply of natural resources including their products and services as well as the basic land, water, and minerals to the year 2000. The projections make a comprehensive, interrelated system consistent with more general projections of population, labor force, production, and income. The authors feel that the picture that emerges will be helpful to anyone who has the responsibility for, or is interested in, the resources futre of the country. The authors also indicate at many points in the book the problems which loom in the future as a result of lack of correspondence between estimated demand and supply. The closing of these gaps is the business of public policy and private management to the extent that the job is not to be done automatically by the price system. Mainly, however, the book serves as a background for considering policies, not as a treatise on policies themselves. The crucial role of water and water resources in the future growth of the economy makes this book of interest to the water planner. (Loeb-Rutgers)
W70-03009

07. RESOURCES DATA

7A. Network Design

ECONOMIC MEASURE OF EFFECT OF EXTREME DATA,
Harvard Univ., Cambridge, Mass. Dept. of Engineering and Applied Physics.
For primary bibliographic entry see Field 06B.
W70-03091

7B. Data Acquisition

MEASUREMENT AND DESCRIPTION OF THE SALINITY OF WATER,
Hunting Technical Services Ltd., Boreham Wood (England).
T. N. Jewitt.
Water Research Foundation of Australia Report No 29, Papers from Symposium on Aspects of Saline Water held at Adelaide, Feb 20-21, 1969, p 2.1-2.22, Sept 1969. 22 p, 8 tab, 7 ref.

Descriptors: *Water quality, *Salinity, *Water chemistry, Hardness (Water), Mineralogy, Water analysis, Aqueous solutions, Saline water systems.
Identifiers: *Australia.

Several standard methods of measuring, classifying, and describing natural saline waters are reviewed and illustrated by examples from studies of Australian waters. Compositions displayed by triangular diagrams, stiff diagrams, and conductivity-concentration plots are compared. (Knapp-USGS)
W70-02853

THE CHESAPEAKE BAY INSTITUTE WAVE FOLLOWER,
Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
Mart Peep, and Ronald J. Flower.
Chesapeake Bay Institute Technical Report 58, Reference No 69-11, Sept 1969. 76 p, 28 fig, 14 ref, 1 append. Contract Nonr 4010 (11); ONR Proj No NR 083-016.

Descriptors: *Instrumentation, *Anemometers, *Waves (Water), *Estuaries, Height, Winds, Flow measurement.
Identifiers: *Wave follower, Hot-wire anemometer, Hot-film anemometer.

The CBI Wave Follower was designed to hold anemometers at fixed distances from 60 cm to 1 cm from a water surface with waves up to 30 cm in height. It allows adjustment for tidal changes in mean water elevation up to 60 cm and for slow vertical scanning. In studies of wave generation an exploration of the wind field close to the water surface is critical. Such an exploration can be made with a hot-wire or film anemometer mounted on a device driven by a servomechanism which will maintain the anemometer at a fixed distance from the fluctuating water surface. (Knapp-USGS)
W70-02872

EVALUATION OF NUCLEAR METHODS OF DETERMINING SURFACE IN SITU SOIL WATER CONTENT AND DENSITY,
Corps of Engineers, Vicksburg, Miss. Waterways Experiment Station.
T. B. Rosser, and S. L. Webster.
Report available from Clearinghouse as AD-688 079 for $3.00 in paper copy, $0.65 in microfiche. Corps Engineers Waterways Experiment Station Miscellaneous Paper S-69-15, Apr 1969. 36 p, 2 fig, 16 plate, 7 ref, 1 append. DA Proj No 4A024401A891.

Descriptors: *Nuclear moisture meters, *Soil moisture meters, *Calibrations, Laboratory tests, On-site tests, Gamma rays, Density, Soil moisture, Soil water, Instrumentation, Moisture content.
Identifiers: Neutron soil moisture meters, Gamma-ray soil moisture meters.

Laboratory tests were made to evaluate accuracy and reliability of measuring surface in situ soil water content and density by the backscatter and direct transmission nuclear methods using a single nuclear device and scaler. The device functioned as a surface backscatter moisture and density meter or as a direct transmission density probe. Five soil types were tested to approximate a full range of possible construction materials. Each soil was tested at 8 different known densities and water contents. To obtain comparative results, soil densities of each sample were determined by 2 accepted conventional field methods (sand-cone and water-balloon). In situ densities by the direct transmission nuclear method using the factory calibration curve furnished with the device were as accurate as densities obtained by the sand-cone and water-balloon methods. The nuclear method using a WES-developed calibration curve provided slightly more accurate density measurements than either conventional method. Densities determined by the surface backscatter nuclear method using both the factory calibration curve and a WES-developed curve were not as accurate as conventional methods. A WES-developed calibration curve was sufficiently accurate for most quality control fieldwork. A test procedure for determining surface layer density and water content of soil by nuclear methods is presented. (Knapp-USGS)
W70-02876

DELINEATION OF SHEAR ZONES AND APPLICATION TO RESERVOIR ENGINEERING USING APOLLO 9 MULTISPECTRAL PHOTOGRAPHY,
Alabama Geological Survey, Tuscaloosa.
William J. Powell, Charles W. Copeland, and James A. Drahovzal.
Alabama Geological Survey, Open-file Report, 1970. 51 p, 13 illus, 3 tab, 5 ref.

Descriptors: *Remote sensing, *Water resources, *Infrared radiation, *Structural geology, Hydrogeology, Groundwater, Streamflow, Low flow, Springs, Water wells, Water yield, Faults (Geology), Alabama, Appalachian Mountain Region.
Identifiers: *Lineations, *Multispectral photography, Apollo 9, Coosa River.

One of the most significant features disclosed by the interpretation of the multispectral Apollo 9 space photographs is the relatively straight long lineations that intersect Appalachian structural axis. Because little or no offset in topographic features is evident along most of the traces, the lineations are thought to represent fractures. Orientation analysis suggests that the fractures result from a reoriented stress field developed some time after the main phase of the Appalachian Mountain building. Apparent coincidence of the lineations with areas of known anomalies of streamflow, of large capacity wells and springs, quarry drainage, and dam leakage problems suggests that lineations may not only be of geologic significance but of great hydrologic, environmental, and economic significance. (Lang-USGS)
W70-03069

SEASONAL VARIATION IN RAIN GAGE CATCH,
Department of Agriculture, Washington, D.C.; and Weather Bureau, Silver Spring, Md.
J. L. McGuinnes, and Grant W. Vaughan.
Paper presented at 50th Annual Meeting of American Geophysical Union, Wash, DC, Apr 21, 1969. 8 p, 2 fig, 2 tab, 11 ref.

Descriptors: *Rain gages, *Precipitation gages, *Calibrations, *Precipitation (Atmospheric), Summer, Winter, Lysimeters, Instrumentation, Rainfall intensity, Seasonal, Nebraska, Ohio, Gaging stations.
Identifiers: Rain gage catch, Rain gage calibration.

In nothern Ohio 8-inch standard rain gages consistently caught more precipitation in summer and less in winter than adjacent digital punch gages, although average annual totals were almost identical. A similar seasonal pattern was found in a comparison of precipitation catch by weighing lysimeters and adjacent weighing-type recording rain gages in Ohio and in a comparison of standard and recording rain gage catch in Nebraska. Some reasons for the differences and their implications are discussed. (Carstea-USGS)
W70-03086

COMPARISON OF VARIOUS METHODS OF DETERMINING EVAPORATION IN AN IRRIGATED FIELD IN THE VAKHSH VALLEY OF TADZHIKISTAN,
For primary bibliographic entry see Field 02D.
W70-03116

ELECTRONICS STARTS SOLVING THE PROBLEMS OF THE CITIES,
Roger K. Field.
Electronic Design, Vol 16, No 1, p 65-93, Jan 4, 1968. 21 fig.

Descriptors: *Electronic equipment, *Remote sensing, *Remote control, *Technology, *Treatment facilities, Water treatment, Water quality control, Telemetry, Computers, Cities, Urbanization, Municipal water, Municipal wastes, Monitoring.
Identifiers: *Electronic technology, *Advanced technology, Aerospace technology, Urban problems.

This field investigation identifies the design problems involved in applying aerospace technology to today's problems. The major problems that the cities face are lack of money and experience in advanced technology. Adaptation of existing military, aerospace and industrial technology has been successful in a few instances. Examples are Sacramento's water distribution system and sewer maintenance program, Los Angeles' air pollution monitoring and water reclamation programs, San Jose, California's computer-controlled traffic system, New York City's rapid-transit communication and routing system, and Chicago's technologically advanced police department. The municipal functions lending themselves most readily to electronic instrumentation are waste disposal and water reclamation. These functions demand special accurate measuring and sensing devices to quantify factors such as turbidity, biochemical oxygen demand and chemical oxygen demand. They also require strip-chart recording devices to display data on a periodic basis. In Sacramento, water level sensors feed electronic signals to control board to pinpoint the location of water back-up problems. Waterproof TV cameras detect construction flaws in underground pipes. (Poertner-Chicago)
W70-03139

7C. Evaluation, Processing and Publication

EVALUATION OF FLOW IN TIDAL REACHES OF THE CONNECTICUT RIVER BY MATHEMATICAL MODEL,
Geological Survey, Washington, D.C.; and Geological Survey, Hartford, Conn.
For primary bibliographic entry see Field 02L.
W70-03075

STANDARDIZATION OF PARTICLE-SIZE RANGES.
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 02J.
W70-03093

LINEAR ROUTING IN UNIFORM OPEN CHANNELS,
University Coll., Cork (Ireland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-03126

EFFECT OF BASIN MORPHOLOGY ON RESPONSE TO FLOOD FLOWS,
Oklahoma State Univ., Stillwater. Bioengineering Labs.; and Oklahoma State Univ., Stillwater. Water Resources Research Inst.
M. Hamdy Bechir, Quintin B. Graves, and Anthony F. Gaudy, Jr.
Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 7, p 46-56, 1967. 11 p, 5 fig, 1 tab. OWRR Project B-006-OKLA.

Descriptors: *Floods, *Illinois, *Computer programs, *Data processing, *Computer models, Streamflow forecasting, Channel morphology, Drainage patterns (Geologic), Flood forecasting, Peak discharge, Synthetic hydrology.
Identifiers: *Illinois River, Drainage basin morphology.

Floods occurring on the Illinois River over the past 30 years were studied, using the United States Geological Survey gaging station records at Tahlequah, Oklahoma. Other gaging stations on the Illinois have partial records covering 10 and 17 year periods. The floods occurring during overlapping period of record were compared and the response was evaluated with respect to flood peak magnitude, length of channel, and morphology of the basin. The comparative behavior of the flows at the gaging stations was incorporated in a computer program. This computer program was used to synthesize flood flows occurring during the period of missing records. (Knapp-USGS)
W70-03127

A DISPERSION ANALOG MODEL FOR WATERSHED SYSTEMS,
Technion - Israel Inst. of Tech., Haifa.
For primary bibliographic entry see Field 02A.
W70-03128

A SIMULATED WATERSHED FLOW SYSTEM FOR HYDROGRAPH PREDICTION; A KINEMATIC APPLICATION,
Agricultural Research Service, Beltsville, Md. Hydrograph Lab.
For primary bibliographic entry see Field 02A.
W70-03129

A CONTRIBUTION TO ANALOGUE AND PHYSICAL MODELING OF SURFACE RUNOFF PROCESS IN SMALL BASINS,
Jaromir Nemec, and Miloslav Moudry.
Proceedings in International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 11, p 80-85, 1967. 6 p, 17 ref.

Descriptors: *Rainfall-runoff relationships, *Model studies, *Analog models, *Hydraulic models, *Mathematical models, Routing, Rainfall disposition, Simulation analysis, Streamflow forecasting, Runoff forecasting.
Identifiers: Watershed models.

In order to evaluate the influence of different elements of the surface runoff process, particularly during flood flow, concentration time is selected as a compound factor. Its variation is analyzed by the use of modeling devices, including the analog electronic model and a physical scale model of a watershed. For electrical modeling the RC electrical analog EMU PR 27, developed by the Hydrometeorological Center of USSR was selected. The theoretical principles and the electronic equivalent of the concentration time are discussed. A simultaneous study of the problem uses a physical scale model of a small experimental watershed, gaged for extended period. The influence of rain intensity on lag time is studied in both models, electronical and physical, as compared with the prototype in nature. (Knapp-USGS)
W70-03135

08. ENGINEERING WORKS

8A. Structures

NUCLEAR BLAST RESISTANT WATER WELLS,
Naval Civil Engineering Lab., Port Hueneme, Calif.
J. A. Norbutas.
Report available from the Clearinghouse as AD-687 704, for $3.00 in paper copy, $0.65 in microfiche. Naval Civil Engineering Laboratory Technical Report R624, Port Hueneme, California, May 1969. 51 p, 10 fig, 3 tab, 35 ref, 5 append. Proj No Y-F011-05-02-353.

Descriptors: *Water wells, *Design, *Nuclear explosions, *Safety, *Construction, Excavation, Nuclear engineering, Seismic waves, Casings, Structural design, Structural engineering, Structural stability.
Identifiers: *Well design, *Well construction, *Blast-resistant wells.

A proposed concept and associated design criteria for blast-resistant water wells are presented. Emphasis is on the design of deep wells for the cooling of hardened shelters. The scope of the study is limited to blast overpressures under 300 psi and weapon yields less than 20 Mt. A unique feature of the concept is the use of a gel-like material to isolate the well casing from blast-induced ground motions. The concept was developed from the results of a survey of reported well damage caused by earthquakes, earth subsidence, and underground detonations; a search of the literature on isolation and hardening techniques; and an analytical study based on existing, unclassified nuclear weapon effects theory. Recommendations are given to field-test the concept and to direct further work toward extending the weapon effects range. (Knapp-USGS)
W70-02865

THE BUCKLING OF STEEL LININGS IN SHAFTS AND TUNNELS,
Wartmann et Cie A.G., Brugg (Switzerland).
Ernst Amstutz.
Schweiz Bauztg, Vol 87, No 28, p 541-549, July 1969. Transl from Ger, Bur Reclam Transl 826, Sept 1969. 23 p, 10 fig, 2 tab, 12 ref.

Descriptors: *Tunnel linings, Shafts (Excavations), *Buckling, *Steel linings, Safety factors, Theory, Deformation, Shear forces, Tension, Bending moments, Foreign research, Stress-strain curves, Displacements, Laboratory tests, Model tests, Groundwater, Failure (Mechanics), Pressure, Economics, Foreign design practices.
Identifiers: Switzerland, Grouting pressure, Stiffeners, Slenderness ratio, Test results.

A theory of buckling of circular steel linings in shafts and tunnels, formulated by the author and accepted in technical literature, is presented. Correctly judging the buckling danger of shaft and tunnel steel liners from grout pressure or external water pressure is economically important. According to this theory, relatively small factors of safety are sufficient to prevent failures. Results of buckling experiments performed on test models are compared with computed theoretical values. Good agreement was obtained with the theory for smooth liners and for liners having shear anchors when correct material constants were used in the theoretical formulas. (USBR)
W70-02941

THE EFFICIENCY OF DOUBLE-SIDED CONTROL DRAINAGE SYSTEMS IN THE UKRAINE (RUSSIAN),
For primary bibliographic entry see Field 04A.
W70-03119

COMBINED UNDERFLOW STORAGE PLAN FOR POLLUTION AND FLOOD CONTROL IN THE CHICAGO METROPOLITAN AREA,
Chicago Bureau of Engineering, Ill.
For primary bibliographic entry see Field 05G.
W70-03142

AQUEDUCT CONTROL SYSTEM SAVES $100 MILLION,
California State Dept. of Water Resources, Sacramento.
Alfred R. Golze.
Power Engineering, p 30-35, Oct 1969. 2 fig, 3 ref.

Descriptors: *Aqueducts, *Water conveyance, *Water delivery, *Water supply, *Water resources development, *Water transfer, Water structure, Water shortage, Construction, Computers, Automatic control.
Identifiers: *California, *Southern California, California Department of Water Resources.

The article describes the concepts and progress of the California State Water Project, the first statewide water resources development in the United States. It is the largest single hydro project in the world to be financed at one time. The estimated cost is over $2.6 billion. An estimated 70 per cent of the State's rainfall occurs north of San Francisco. The project includes construction of a 450 mile aqueduct to transport this water to the drier areas in southern California. Construction began in 1961 and is near the halfway mark. The eight power generating facilities along the waterway will provide a maximum annual output of 6.2 billion kilowatt hours. In the overall system there will be 27 pumping stations and power plants having a total of 170 separate electrical-mechanical units; 66 check structures with 213 separate gates; and a minimum of 49 major water turnout structures where deliveries will be made to customers. Each of the pumping plants has been designed for computer control and each is interfaced with the aqueduct control system so that remote manual or computer control of each plant is possible. The completion date is set for 1972. (Poertner-Chicago)
W70-03146

URBAN STORM DRAINAGE CRITERIA MANUAL.
Wright-McLaughlin Engineers, Denver, Colo.
For primary bibliographic entry see Field 04A.
W70-03148

STORM SEWERS (Chapter 6); STREETS AND INTERSECTIONS (Chapter 7); AND STORM WATER INLETS (Chapter 8).
Wright-McLaughlin Engineers, Denver, Colo
For primary bibliographic entry see Field 04A
W70-03152

8B. Hydraulics

THE MOVEMENT OF SALINE/FRESH WATER SYSTEMS,
Adelaide Univ. (Australia). Dept. of Civil Engineering.
R. Culver.
Water Research Foundation of Australia Report No 29, Papers from Symposium on Aspects of Saline Water held at Adelaide, Feb 20-21, 1969, p 5.1-5.10, Sept 1969. 10 p, 1 fig, 10 ref.

Descriptors: *Stratified flow, *Density stratification, *Saline water systems, Open channel flow, Porous media, Groundwater movement, Interfaces, Diffusion, Dispersion, Mixing, Saline water-freshwater interfaces, Boundary processes, Shear drag.
Identifiers: Saline-freshwater systems.

The elements of the mechanics of movement of saline-freshwater systems in free water bodies and in porous media are outlined. Methods are presented for calculation of stratified flow, diffusion, interface behavior, dispersion, and mixing in free, open channel, and conduit flows. (Knapp-USGS)
W70-02855

LAND SUBSIDENCE DUE TO WITHDRAWAL OF FLUIDS,
Geological Survey, Sacramento, Calif.; and Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02F.
W70-02861

RESPONSE OF A LABORATORY ALLUVIAL CHANNEL TO CHANGES OF HYDRAULIC AND SEDIMENT-TRANSPORT VARIABLES,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02J.
W70-02880

A METHOD OF ANALYZING TRANSIENT FLUID IN MULTILAYERED AQUIFERS,
Pahlavi Univ., Shiraz (Iran); California Univ., Berkeley.
For primary bibliographic entry see Field 02F.
W70-02943

NEEDLE VALVES AS PRESSURE REGULATORS,
Colorado State Univ., Fort Collins.
J. Paul Tullis, and Maurice L. Albertson.
Proc Amer Soc Civ Eng, J Hydraul Div, Vol 95, No HY5, p 1633-1649, Sept 1969. 17 p, 7 fig, 13 ref, append.

Descriptors: *Cavitation, *Pressure regulators, *Needle valves, *Energy dissipation, Jets, Hydraulic gates and valves, Closed conduits, Valves, Hydraulics, Water control, Research and development, Erosion, Fluid mechanics, Laboratory tests, Orifices, Submerged orifices.
Identifiers: *Energy dissipators, Cavitation control, Submerged flow, Test results, Cavitation index.

The potential of needle valves issuing into sudden expansions as primary components of large closed conduit pressure regulating structures is analyzed. Results of research projects conducted to evaluate hydraulic characteristics of needle valves are presented. Flow characteristics of the needle valve are described by presenting a submerged jet issuing from a circular orifice into an expansion chamber. Basic principles and equations of fluid mechanics are applied to predict qualitatively the cavitation, pressure fluctuation, and energy dissipation capa-

bilities of submerged jets. A literature review of related studies is presented, and a description of facilities used for testing is given. Tests indicate that needle valves are ideally suited for pressure regulation in closed conduit systems, having the capability of dissipating large amounts of energy with little cavitation or pressure fluctuation. Special attention should be given to the design to maximize the streamlining of the valve and to eliminate the possibility of local cavitation zones. (USBR)
W70-02960

DISPERSIVITY TENSOR FOR TURBULENT UNIFORM CHANNEL FLOW,
Hydronautics, Inc., Laurel, Md.
Gedeon Dagan.
Proc Amer Soc Civ Eng, J Hydraul Div, Vol 95, No HY5, p 1699-1712, Sept 1969. 14 p, 3 fig, 20 ref, 2 append.

Descriptors: *Dispersion, *Turbulent flow, *Streamflow, *Channel flow, *Uniform flow, Hydraulics, Thermal pollution, Two-dimensional, Reynolds number, Three-dimensional, Bibliographies.
Identifiers: *Thermal diffusion, Isovels.

The turbulent mixing of a solute in a streamflow is described with the aid of the dispersivity tensor. In a 2-dimensional pipe or wide channel flow, only the radial (vertical) dispersivity coefficient is significant and is usually determined through the Reynolds analogy. The analogy is extended to a 3-dimensional (channel of arbitrary section) uniform flow. The mixing length theory leads to the representation of the dispersivity tensor in terms of 2 distinct coefficients: (1) a coefficient representing mixing normal to isovels found through Reynolds analogy; and (2) a lateral dispersivity coefficient that must be determined from dispersivity measurements. (USBR)
W70-02962

MECHANICS OF FLOW FROM STRATIFIED RESERVOIRS IN THE INTEREST OF WATER QUALITY; HYDRAULIC LABORATORY INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
Joseph P. Bohan, and John L. Grace, Jr.
Waterways Experiment Station, Technical Report H-69-10, July 1969. 84 p, 12 tab, 23 ref.

Descriptors: Computer programs, *Hydraulic models, Intakes structures, *Reservoirs, *Stratified flow, Water quality.

Investigations were conducted to determine the characteristics of the withdrawal zone resulting from the release of flow through an orifice from a randomly stratified reservoir in experimental facilities for the purpose of developing means of predicting the quality of water discharged through similar openings in prototype intake structures. Distributions of density, generated by differentials in both temperature and dissolved salt concentration, and velocity were observed at various locations within a 1-ft-wide channel upstream of 0.08and 0.16-ft-square orifices. These data were used to develop generalized expressions describing the limits of the zone of withdrawal and the distribution of velocities therein. In certain cases, the proximity of the free surface and/or bottom boundary may dictate the upper and/or lower limits of the zone of withdrawal. Means were developed (Appendix A) for evaluating the conditions under which these boundaries dictate the limits of the withdrawal zone and for determining the distribution of velocities within a zone of withdrawal restricted by boundary conditions. A sample problem (Appendix B) is presented to illustrate application of the results to determine the maximum discharge that may be released through a square orifice for a given set of conditions without exceeding the limits of a desired hypothetical zone of withdrawal. The example also illustrates how the actual limits of the zone of withdrawal and the velocity distribution therein are determined. A method is illustrated for predicting the dissolved oxygen content and/or other water quality parameters of the outflow provided the vertical distributions of these parameters in the reservoir are known. A FORTRAN IV program is presented in Appendix C. This program can be used to solve three different approaches to the selective withdrawal problem: (1) determination of the allowable discharge for selected withdrawal limits and orifice size and elevation; (2) determination of the withdrawal zone characteristics for a selected discharge and orifice size and elevation; and (3) determination of the allowable discharge and orifice elevation for selected withdrawal limits and orifice size. The density and/or temperature profile in the reservoir must be known or assumed for all three conditions. The effect of orifice shape on the withdrawal characteristics was tested and analyzed after the draft of this report was prepared. The results were believed to be pertinent and are discussed briefly in the Discussion section of this report.
W70-03027

WEBBERS FALLS LOCK AND DAM, ARKANSAS RIVER NAVIGATION PROJECT; HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
John J. Franco, and James E. Glover.
Waterways Experiment Station, Technical Report H-69-11, Aug 1969. 41 p.

Descriptors: *Channel flow, *Hydraulic models, Locks, Navigation.
Identifiers: *Arkansas River, *Navigation dams, Webbers Falls Lock and Dam.

Webbers Falls Lock and Dam will comprise a nonnavigable dam of 12 gated spillway bays, a 110- by 600-ft lock on the left bank, and a three-unit powerhouse with a discharge capacity of 35,500 cfs on the right bank. A 1:120-scale fixed-bed model was used to determine flood stages at the dam, navigation conditions in the lock approaches, tendency for sediment deposition in the lower lock approach, and magnitude of surges generated in the upper lock approach canal by lock filling, and to develop modifications required to provide satisfactory conditions. Modifications to the original design required to produce satisfactory navigation conditions in the approaches to the lock were developed and flow conditions through the spillway were improved. In general, results have indicated: Realignment of the entrance to the upper lock approach canal would be required to eliminate hazardous conditions for downbound tows attempting to enter the canal. Ports would be required in the upper guard wall to reduce crosscurrents near the entrance to the upper lock approach canal and to reduce surges resulting from lock filling operations. Surges would develop in the upper lock approach canal from lock filling operations. Magnitude of the surge could be reduced so that it would have no serious effect on navigation with ports in the upper guard wall and a surge basin near the lock. Water-surface elevations at the dam embankment to the left of the lock could be lowered by structures designed to eliminate overbank flow toward the embankment and improve the alignment of currents approaching the spillway. Sediment below the dam would be moved into the lower approach channel and could produce shoaling. Size of the surge basin and length of the upper guard wall could be reduced without any appreciable effect on navigation. The amount of excavation in the approach to the spillway could be reduced appreciably without affecting flow through the spillway.
W70-03028

GALVESTON BAY HURRICANE SURGE STUDY; REPORT 1, EFFECTS OF PROPOSED BARRIERS ON HURRICANE SURGE HEIGHTS; HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
Noble J. Brogdon, Jr.
Waterways Experiment Station, Technical Report H-69-12, (Report 1), Sept 1969. 167 p.

Descriptors: *Hurricanes, Floods, *Hydraulic models, *Surges.
Identifiers: *Galveston Bay, *Hurricane barriers.

Design of barriers for protection of all or portions of Galveston Bay against inundation by hurricane surges required the use of hydraulic model studies of the Galveston Bay complex to verify the results of surge routings by analytical methods and to determine the effects of all proposed structures on normal tides and hurricane surge heights upstream and downstream from barrier sites. The Galveston Bay hurricane surge model reproduced the coast from Freeport on the south to High Island on Bolivar Peninsula on the east. The model included an average width of the Gulf of Mexico of about 25 miles, measured normal to the gulf; all of the barrier islands in the bay interior, including its many connecting arms, lakes, and lagoons; and the coastal area within this sector up to a maximum elevation of 20 ft msl; and reproduced normal tides as well as gulf surges created by hurricane forces. The model was of the fixed-bed type molded of concrete to linear scale ratios, model to prototype, of 1:100 vertically and 1:3000 horizontally. Automatic tide generators reproduced normal tides and tidal currents throughout the model. Hurricane surges were reproduced by a horizontal-displacement type surge generator. Either of the two major hurricane protection plans tested would provide protection for the area inland from the barrier when the navigation openings were closed. The Alpha plan, located on the coastline of the Gulf of Mexico, would provide protection for a greater area since it shelters practically the entire area inland from the coastline. The Gamma plan leaves unprotected a major portion of West Bay, the entire city of Galveston, and all of East Bay. The Texas City, LaMarque-Hitchcock system, when completed, will provide protection for these towns from surges of 15 ft msl.
W70-03029

LOW-WATER WEIRS ON BOEUF AND TENSAS RIVERS, BAYOU MACON, AND BIG AND COLEWA CREEKS, ARKANSAS AND LOUISIANA; HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
Jackson H. Ables, Jr., and Marden B. Boyd.
Waterways Experiment Station, Technical Report H-69-13, Oct 1969. 41 p, 2 tab, 10 photo, 10 fig, append.

Descriptors: *Channel improvement, *Hydraulic models, Riprap, *Weirs.
Identifiers: Big Creek, Ark.; Boeuf River, Colewa Creek, Ark.; Macon Bayou, Tensas River.

A 1:20-scale model reproducing one-half of the channel section through a low-water weir was used to test eight plans of channel improvement. The tests were conducted with a drop height of 5.5 ft, and discharges up to 10,000 cfs were observed. Flow conditions and slope protection downstream from the weir to control the flanking problem were found to be satisfactory with channel improvement plans 6 and 8. Riprap with an average weight of 33 lb was used in slope protection in both plans. A model headwater-tailwater rating curve was obtained. A second 1:20-scale section model was constructed in a 2.5-ft-wide glass flume for more generalized riprap tests in the vicinity of the structure. Several drop structure plans were observed to develop an effective, economical drop structure. Of primary concern were development of some of the dimensions of various elements of the structure and determination of riprap requirements in the vicinity of the structure. Limiting tailwater curves for 220- and 325-lb riprap are furnished as a guide in riprap selection at drop structures with drop heights of from 5 to 10 ft. Suggestions as to the use of these curves also are included. A basin length of 20 ft is considered to be adequate at projects where the jet will ride through at unit discharges exceed-

ing about 10 cfs. It is recommended that the entire 20 ft be protected by riprap of the same size, whether 220- or 325-lb stone. A riprap plan which provides additional protection to the structure is presented in Appendix A. This plan was not considered warranted for initial construction because of increased cost. However, at weirs where maintenance is required it is planned that this work be performed so as to approach the riprap configuration proposed in Appendix A.
W70-03030

OUTLET WORKS FOR NEW HOPE RESERVOIR, CAPE FEAR RIVER BASIN, NORTH CAROLINA, HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
Edwin S. Melsheimer, and Noel R. Oswalt.
Waterways Experiment Station Technical Report H-69-14, Oct 1969. 4 tab, 5 photo, 14 fig. 46 p.

Descriptors: *Hydraulic models, *Outlet works, Stilling basins, Flow, North Carolina.
Identifiers: *New Hope Reservoir, Cape Fear River Basin.

Model investigation of the outlet works for the New Hope Reservoir was initially concerned with verification and improvement of the hydraulic design of the intake structure, conduit, and stilling basin. Subsequent tests involved observations of the effectiveness of the multilevel intakes in providing selective withdrawal of flow from the epilimnion or upper stratum of a stratified reservoir. The study was conducted in a 1:20-scale model of the outlet works which reproduced a portion of the approach area, the intake structure, the outlet conduit, the hydraulic-jump type stilling basin, and approximately 800 ft of exit channel. The proposed intake structure provided effective regulation of flood-control releases as well as those which are desired to to provide quality water downstream during both summer and winter. However, certain operational procedures are necessary to prevent dangerous subatmospheric pressures in the throat section of the water-quality system. Flow conditions in the original conduit intakes, throughout the flood-control facilities, and downstream to the conduit outlet were satisfactory with pressure conditions remaining positive for all discharges with little or no fluctuation. There was no tendency for structural vibration with either flood-control or water-quality flows. Performance of the original design stilling basin was unacceptable as unstable hydraulic action and eddy formation resulted in very turbulent basin conditions with little or no energy dissipation. Raising the elevation of the basin and lengthening and modifying the transition section (types 2 and 3 basins) resulted in adequate, if not ideal, performance. Single gate operation produced unbalanced flow in the basin; however, as single gate operation is rarely necessary, types 2 and 3 basins are considered acceptable for prototype construction. It was determined that riprap protection is required on both banks of the exit channel.
W70-03031

SPILLWAY FOR HUGO DAM, KIAMICHI RIVER, OKLAHOMA; HYDRAULIC INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
Bobby P. Fletcher, and John L. Grace, Jr.
Waterways Experiment Station Technical Report H-69-15, Nov 1969. 55 p, 1 tab, 14 photo, 24 fig.

Descriptors: *Hydraulic models, *Spillways, Kiamichi River, Oklahoma.
Identifiers: *Hugo Dam.

Model investigations were conducted to determine the adequacy of a gravity type spillway to be located on the Kiamichi River, Okla., for flood control, water supply, recreation, and fish and wildlife purposes. The investigation of the Hugo Dam spillway were primarily concerned with flow conditions in the approach channel, stilling basin, and exit channel. The model indicated that features of the original design structure were unsatisfactory; however, certain modifications that improved hydraulic performance and reduced construction costs were developed. The capacity of the spillway as determined with the model was greater than that computed. Subsequent modifications to the spillway design to effect economy and eliminate surging at the abutments did not affect the capacity. The performance of the original design stilling basin was satisfactory in the dissipation of all spillway discharges. However, alternate designs were developed to reduce construction costs without impairing hydraulic performance. The size and placement of riprap in the approach and exit channel were determined by model tests.
W70-03032

CHANNEL IMPROVEMENT, FIRE ISLAND INLET, NEW YORK; HYDRAULIC MODEL INVESTIGATION,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
William H. Bobb, and Robert A. Boland, Jr.
Waterways Experiment Station, Technical Report H-69-16, Nov 1969. 261 p, 1 tab, 13 photo, 206 fig.

Descriptors: *Channel improvements, *Hydraulic models, Littoral drift, Shoals, New York.
Identifiers: *Fire Island Inlet, N.Y.

Fire Island Inlet, located on the south shore of Long Island, N.Y., connects the Atlantic Ocean with Great South Bay. The inlet is about 3 miles long and approximately 1/2 mile wide, extending generally east and west between Oak Beach on the north and the western end of Fire Island on the south. Great South Bay, to which Fire Island Inlet is the main entrance, is a tidal body 25 miles long and 2 to 5 miles wide with a general depth of about 6 to 25 ft at mlw. Attempts have been made to stabilize an entrance channel through Fire Island Inlet with little success. To study this problem a fixed-bed model (later converted to a movable-bed model) was constructed to scale ratios of 1:500 horizontally and 1:100 vertically, reproducing all of Fire Island Inlet and a portion of the Atlantic Ocean. Tides, tidal currents, and wave action in the Atlantic Ocean were reproduced. Results indicated that the plan originally recommended by the New York District, which included a littoral drift trap located in the entrance to the inlet, a rehandling basin in the inlet, a connecting channel of adequate depth for navigation by a loaded hopper dredge, and a 500-ft extension to the Federal Jetty, if modified to include a larger rehandling basin but without extension of the Federal Jetty, would meet all requirements for a combination scheme to stabilize the entrance channel and permit bypassing sand to downdrift beaches by means of conventional dredging plant. The construction of groins, deflection dikes, and closure dikes would not appreciably improve conditions obtained by the recommended plan alone. A plan involving an offshore breakwater and a littoral drift trap located between the breakwater and the beach would also function satisfactorily in every respect.
W70-03033

HYDRAULIC COMPUTATION OF FLOOD-PLAIN CHANNELS,
Le Van Kiyen.
Transl from Gidrotekhnika i Melioratsiya, No 9, p 50-52, 1968. Soviet Hydrology: Selected Papers, No 4, p 360-362, 1968. 1 tab, 3 ref.

Descriptors: *Channels, *Channel morphology, Flood plains, Rivers, Hydraulic properties, Chezy equation, Flood forecasting, Streamflow forecasting, Hydraulics, Model studies, Hydraulic models.
Identifiers: *USSR.

Field observations and over 300 laboratory experiments were used in the Hydraulic Laboratory of the Moscow Hydrometeorological Institute in order to obtain data for hydraulic computation of flood-plain channels. Two dimensionless coefficients allow for the main characteristics of the flood plain channel. Formulas for computation are given and discussed. (Carstea-USGS)
W70-03113

8C. Hydraulic Machinery

THE USES OF TURBINE INLET VALVES,
R. E. Passmore.
Water Power, Vol 21, No 9, p 347-351, Sept 1969. 5 p, 2 fig, 1 tab, append.

Descriptors: *Hydraulic turbines, Penstocks, *Hydraulic gates and valves, Intake gates, *Leakage, Benefits, Economics, Investigations, Repairing, Maintenance costs, Foreign research, Intake structures, Bulkhead gates, Gate seals, Costs, Hydraulic equipment, *Hydraulic valves.
Identifiers: *Wicket gates, Canada, Hydraulic pressure, Headworks.

When studies for hydroelectric developments show the most suitable scheme to be one having individual penstocks to each unit, inlet valves are not required for turbine isolation; then, inclusion of the valves must be justified on another basis. Shutoff devices at or immediately ahead of the turbine gates will prevent wear and provide additional benefits. Requirements for and economic justification of a shutoff device must be examined. Valve installation is required: (1) for unit isolation; (2) for penstock or power conduit protection; (3) for replacement of intake gates; or (4) for isolation of turbines from individual penstocks. The possible need for valves is examined for the situation covered by factor (4), and a formula is given for determining the annual cost of losses incurred by leakage through the turbine wicket gates when no inlet valve is provided. (USBR)
W70-02947

ENVIRONMENTAL CONSIDERATIONS IN DESIGN OF TRANSMISSION LINES,
Bureau of Reclamation, Denver, Colo.
Harry Brenman, and Dwight A. Covington.
Prepr 927, Amer Soc Civ Eng Nat Meet Transp Eng, Wash, DC, July 1969. 28 p, 13 fig, 3 ref, append.

Descriptors: *Aesthetics, *Transmission towers, *Transmission lines, Construction, Design, *Environmental engineering, Impact environment, Natural resources, Landscaping, Revegetation, Access roads, Maintenance, Power operation and maintenance, Right-of-way, Clearing.
Identifiers: Landscapes, *Beautification, Bureau of Reclamation.

The electric power industry has an important responsibility in facing up to the demands that have been alerted by the impact of our installations on the surroundings. The prime objective of transmission lines is to establish and maintain reliable electric service. However, the time has come when the environment in which we live must also be considered. Transmission line engineers must: (1) consider alinement and tower appearance in the design stage; (2) integrate, blend, and conceal the line with the surrounding environment; and (3) develop aesthetically acceptable structures. (USBR)
W70-02948

ALUMINUM VS STEEL IN TRANSMISSION LINE STRUCTURES,
L. A. Kirkpatrick.
Metal Progr, Vol 96, No 3, p 82-84, Sept 1969. 3 p, 2 fig.

Descriptors: *Transmission towers, *Guyed towers, *Aluminum, Optimum design, Electric power, Helicopters, Costs, Cost comparisons, Transmission (Electrical), Maintenance costs, Foreign design practices, Footings, Erection, Transportation.

Identifiers: *Aluminum towers, *Galvanized steel, *Comparative studies, Canada, Aluminum V-towers.

Aluminum transmission line towers have made inroads into the field of transmission line construction. Design innovations that have evolved are: (1) pinning the legs to the lower chord of the crossarm rather than extending the legs through the crossarm to the ground wire peaks; (2) using 8 guys to 4 anchors to aid in balancing leg loads and optimizing design; (3) using a Y-configuration with 8 guys as a means of minimizing leg sections; and (4) developing a pin connection at the junction of the Y combined with 8 guys to produce a structure having maximum ability to withstand transverse loads. Advantages of aluminum towers are discussed and ways that aluminum can compete with galvanized steel are reviewed. Initially, costs will be higher for aluminum towers than for steel towers, but a complete evaluation in determining the optimum structure for the installation is required. Expanding use of helicopters in transmission line construction will effect many savings. (USBR)
W70-02951

CHALLENGES OF UNDERGROUND TRANSMISSION AND DISTRIBUTION,
Commonwealth Edison Co., Northbrook, Ill.; and Commonwealth Edison Co., Maywood, Ill.
D. W. Gilman, and E. J. Steeve.
Prepr 956, Amer Soc Civ Eng Nat Meet Transp Eng, Wash, DC, July 1969. 14 p, 2 fig.

Descriptors: *Transmission (Electrical), *Transmission lines, *Electric power industry, Electric power costs, Costs, Electric power, Reliability, Design, Aesthetic, Right-of-way, Research and development, Environmental effects, Heat transfer, Economics, Electric insulation, Faults (Electrical), Failure (Power), Technology.
Identifiers: *Underground cables, *Underground transmission lines, Pipe-type cables, *Buried cables, Service life, Dielectric properties.

Transmitting electrical energy beneath the surface of the earth presents many challenges. The problems of capacity, reliability, and security seem to defy economic solution with present technology. The electric power industry has undertaken an expanded research effort aimed at removing the barriers to underground powerlines. Two primary motivations for underground transmission are the increasing cost of right-of-way space and the aesthetic compatibility with the environment. Basic differences between overhead and underground lines are described to clarify the engineering and construction problems in economically matching an underground cable to an equivalent overhead line. An understanding of the fundamentals of underground cable design leads to an appreciation of the challenges of undergrounding. Transporting electric energy is divided into 2 subclassifications, distribution and transmission. Costs of underground residential distribution (URD) have been reduced to where this type of curcuit is being widely used. The reliability of several high-voltage underground installations is noted. The cost of underground distribution and transmission lines is discussed and a line cost vs line capability graph presented. (USBR)
W70-02957

8D. Soil Mechanics

THE EFFICIENCY OF HORIZONTAL DRAINAGE LAYERS FOR ACCELERATING CONSOLIDATION OF CLAY EMBANKMENTS,
King's Coll., London (England).
R. E. Gibson, and Gilliane C. Shefford.
Bldg Res Sta Curr Pap, CP 24/69, p 327-335, June 1969. 9 p, 7 fig, 2 tab, 7 ref.

Descriptors: *Consolidation, *Drains, *Clays, *Embankments, *Horizontal drains, Drainage, Drainage practices, Pore water pressures, Drainage systems, Earth dams, Efficiencies, Permeability, Pore pressure, Pressure distribution, Design criteria, Soil engineering, Stabilization, Fills, Soil mechanics, Foreign research.
Identifiers: Drain spacing soil characteristics, Great Britain.

Efficiency of drainage layers in accelerating consolidation of clay embankments is considered and the influence of such factors as layer thickness, length, and permeability is examined. In order to be fully effective, a drain should have a permeability at least 1,000,000 times that of the surrounding clay fill, although an acceptable efficiency would be achieved with a ratio of about 30,000. A drainage blanket only 1,000 times more pervious than the fill is probably useless. (USBR)
W70-02953

8E. Rock Mechanics and Geology

THE EFFECT OF SATURATION ON VELOCITY IN LOW POROSITY ROCKS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.
Amos Nur, and Gene Simmons.
Earth and Planetary Science Letters, Vol 7, No 2, p 183-193, Nov 1969. 11 p, 6 fig, 3 tab, 24 ref.

Descriptors: *Seismic studies, *Seismic properties, *Velocity, *Porous media, *Saturation, Fractures (Geology), Vibrations, Sound waves, Geophysics, Rocks, Geology, Rock properties, Voids.
Identifiers: Seismic velocity-pore geometry relations.

Seismic velocities are often significantly lower near atmospheric pressure than at pressures of a few kilobars in dry rocks with fracture porosity. When such cracks are filled with water, however, this lowering of velocity is significantly diminished for compressional waves. In contrast shear velocity is unaffected by the presence of fluid; low velocity persists at low pressure. The shape of the pores in typical crystalline rocks plays an important role: increase in compressional velocity due to saturation of pores occurs when the pores are in the form of cracks but not when they are in the form of round holes. As differences in compressional velocity of dry and saturated rock at low pressure may approach 50%, the degree of saturation of rocks must be taken into account in many engineering and shallow seismic applications. (Knapp-USGS)
W70-02862

THE EFFECT OF VISCOSITY OF A FLUID PHASE ON VELOCITY IN LOW POROSITY ROCKS,
Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.
Amos Nur, and Gene Simmons.
Earth and Planetary Science Letters, Vol 7, No 2, p 99-108, Nov 1969. 10 p, 5 fig, 2 tab, 35 ref. AEC Contract No AT (30-1)-3966.

Descriptors: *Seismic studies, *Seismic properties, *Velocity, *Viscosity, *Porous media, Fractures (Geology), Vibrations, Saturation, Sound waves, Geophysics, Rocks, Geology, Rock properties, Voids.
Identifiers: Seismic velocity-porefluid relations.

The effective shear modulus of a low porosity rock depends strongly on the viscosity of any fluid phase present in the microcracks. The bulk modulus is essentially independent. These results applied to the earth show remarkable agreement between the laboratory data and the facts known about the velocity zone in the upper mantle. (Knapp-USGS)
W70-02863

8F. Concrete

CALCULATIONS FOR PRESTRESSED PRESSURE TUNNEL LININGS,
Z. Radosavljevic.
Trans, Inst Vodoprivredu Jaroslav Cerni, Vol 14, No 44, p 13-24, 1968. 12 p, 7 fig, 3 tab, 3 ref.

Descriptors: *Pressure tunnels, Prestressed concrete, *Tunnel linings, *Prestressing, Tunnel design, Tunnel pressures, Grouting, Stress, Radial stress, *Stress relieving, Elastic deformation, Shrinkage, Calculations, Creep, Deformation, Cement grouting, Tunnels, Rock properties, Rock mechanics, Equations, Foreign design practices.
Identifiers: Pressure effects, *Stress relaxation, *Concrete linings, Concrete properties, Yugoslavia, Rama Hydroelec Proj (Yugoslavia).

Conventional concrete linings are not satisfactory for high-pressure tunnels because high pressures lead to cracking of concrete and a consequent rise in permeability. The requirement of impermeability is met primarily by using linings that are prestressed by a corset of high-pressure cement grouting, leading to a permanent state of compressive stress. To determine the necessary prestressing, the amount of stress relaxation that will occur must be determined. Prestressed linings exhibit stress relaxation because of (1) creep in the linings; (2) concrete shrinkage; (3) rock creep; and (4) shrinking, creep, and expansion of the hardened cement grout. Equations and sample calculations are given for determining stress relaxation. The pressure drop for prestressed linings lies within the 50-80% range and is primarily caused by creep in the concrete; next in order of influence are concrete shrinkage and low deformability of the rock. The influence of the elasticity, shrinkage, and creep of the hardened grout, and of the gap between lining and rock amounts to less than 3% and can be neglected in comparison with other factors. (USBR)
W70-02946

REINFORCEMENT YIELD CONDITIONS OF A REINFORCED CONCRETE MEDIUM WITH CRACKS,
N. I. Karpenko.
Stroit Mekh Raschet Sooruzhenii, No 2, p 24-26, Mar and Apr 1968. Transl from Russ, Bur Reclam Transl 743, Oct 1969. 10 p, 1 fig, 5 ref.

Descriptors: *Reinforced concrete, *Slabs, *Reinforcement, Structural engineering, Yield point, Yield strength, *Cracks, Equations, Strength, Elastic theory, Theory, Foreign design practices, Normal stress, Bending moments, Moments, Stress, Tensile stress, *Mathematical analysis, Stress analysis, Shear stress, Two-dimensional, Three-dimensional.
Identifiers: *Concrete slabs, Yield line theory, USSR, Compressive stress, *Yielding.

Yield line analysis is used to develop equations for reinforcement yield conditions in a slab. Concrete and reinforcement will carry the load in areas where cracks do not intersect; concrete is excluded from carrying any load at points where 2 or more yield cracks intersect. Equations are developed for each case. Limits for application of the equation are set. Elastic analysis is used to develop the conditions of strength and a characteristic equation for a 2-dimensional stressed state, and to develop the yield conditions for reinforcement in 3 mutually perpendicular directions. (USBR)
W70-02950

THE APPLICATION OF SPRAYED CONCRETE AND SURFACE CEMENTATION FOR ANCHORING THE ROCK FOUNDATION OF THE SHORE ABUTMENTS ON THE ASWAN HIGH DAM,
V. I. Savin.
Hydrotech Constr, No 11, p 984-990, Nov 1968. 7 p, 7 fig, 3 tab.

Descriptors: *Abutments, *Grouting, *Rock foundations, *Dam construction, *Gunite, Concretes, Concrete mixes, Concrete placing, Concrete construction, Earth dams, Cutoffs, Trenches, Grout curtains, Foreign construction, Excavation, Dam foundations.
Identifiers: *Sprayed concrete, *Surface treatment, Concrete linings, Grout mixes, Aswan Dam (UAR).

Shore abutments for the core and upstream apron of the Aswan High Dam are trenches cut down to solid rock. The sides of the excavation have a 5:1 slope. Rock surfaces were covered with sprayed concrete 10 cm thick over the contact area between the rock and clay core. The purposes of the sprayed concrete cover are to: (1) form a base for the surface cementation, (2) prevent grout emerging from the rock surface, (3) provide a facing for the rock surface to prevent entrainment of clay particles along the rock/clay contact in the event of seepage, (4) set up a joining surface between the clay core and foundation, and (5) preserve the rock against erosion. Surface cementation was applied by grouting to a depth of 3 m. Deep grouting of the rock was performed along the axis of the dam and along the contour of the upstream apron shore abutments. The concrete spraying and grouting operations are described. (USBR)
W70-02958

8G. Materials

GENERALIZED VARIATIONAL PRINCIPLES IN THE FINITE-ELEMENT METHOD,
Boeing Co., Seattle, Wash.; and Vermont Univ., Burlington.
B. E. Greene, R. E. Jones, and R. W. McLay.
Amer Inst Aeronautic Astronaut J, Vol 7, No 7, p 1254-1260, July 1969. 7 p, 9 fig, 12 ref, append.

Descriptors: *Plates, *Shell structures, *Structural analysis, Deformation, Bending, Theory, Theoretical analysis, Displacements, Mathematical analysis, Deflection, Structural engineering, Finite differences, Stiffness.
Identifiers: *Finite element method, Static behavior, Matrix methods (Structural), Dynamic response.

In many situations, using pure oxygen offers an economically competitive alternative for artificial aeration of rivers and impoundments. Proper design of the oxygen injection system can make using pure oxygen very advantageous and achieve efficient absorption. The judicious selection of an oxygen injection system can result in side benefits and flexibility not possible when using air. The application of pure oxygen is economically competitive with air when attempting to aerate water that is about 50% saturated with dissolved oxygen or when attempting to achieve near-saturation concentrations in the effluent. Nitrogen concentration can present a serious problem when fish are involved, but can be alleviated by using pure oxygen. (USBR)
W70-02954

OPERATIONS AND PERFORMANCE OF NEW DISTANCE MEASURING INSTRUMENTS,
Environmental Science Services Administration, Rockville, Md.
Raymond W. Tomlinson.
Prepr 985, Amer Soc Civ Eng Nat Meet Transp Eng, Wash, DC, July 1969. 12 p, 1 fig, 1 tab.

Descriptors: *Surveying instruments, *Tellurometers, *Measuring instruments, Surveys, Measurement, Operations, Distance, Performance, Equipment, Testing.
Identifiers: Accuracy, Procedures.

Results are given of tests conducted by the US Coast and Geodetic Survey on the Wild Distomat DI-10 and the Tellurometer MA 100 distance measuring instruments, designed for precision on short distances. Both were easily operated by one person and the performance was very good. Persons with experience in operating microwave and electro-optical instruments need less than one-half day of instructions to obtain accurate measurements. Persons without field experience on this type of equipment should be given a 2- or 3-day training course under field conditions to become proficient operators. Because of the ease of operation and low price of a system, use of the instruments will result in better accuracy, increased production, and lower cost per mile of traverse projects. All field tests conducted for the DI-10 and MA 100 indicate that operation and performance will give accuracies of 1/50,000 or better within the claimed range. Results of measuring the same taped distances with each instrument are given. (USBR)
W70-02956

8I. Fisheries Engineering

FISH HATCHERIES AND FISH PROPAGATION.
For primary bibliographic entry see Field 06E.
W70-03194

09. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

EDUCATION IN HYDROLOGY, UNITED STATES UNIVERSITIES-EARLY 1966.
Universities Council on Water Resources, Austin, Tex.

Texas Univ Report of Universities Council on Water Resources (UCOWR), July 1967. 44 p, 17 fig, 11 tab, 7 ref, 4 append. NSF Grant GE-7013 to Calif Univ, Los Angeles.

Descriptors: *Education, *Universities, *Hydrology, *United States, Engineering education, Training, Schools (Education), Surveys, Colleges.
Identifiers: Hydrology education.

At the institution surveyed, 859 faculty members reported some involvement with Hydrology education or research. The number of faculty members per institution varied from 1 to 42, with the median number being 8. Over half (52%) of the faculty have a background in Engineering, 22% in Biological Sciences, 20% in Earth Sciences and 6% in Other Fields. On the average, about 1/3 of faculty time is devoted to teaching, over 1/3 to research, and about 1/5 to public service or extension. Current effort occurs chiefly in Engineering, exceeding the combined effort in Earth Sciences and Biological Sciences departments. Most institutions offered courses with Hydrology content in several departments. Engineering departments offered more semester hours of Hydrology than the sum for the Earth Sciences and Biological Sciences departments. Civil Engineering departments account for about 306 students, while Forestry, Geology, Botony, Agricultural Engineering and Meteorology account for the remainder of a total of 340 students. In general, it is clear that the amount of student financial support available is low in those departments which produce the largest number of graduate degrees emphasizing Hydrology; these are Civil Engineering, Forestry, Geology, Botony, Agricultural Engineering, and Meteorology. (Knapp-USGS)
W70-02894

9C. Research Facilities

SUPPLY OF AND DEMAND FOR TRAINED WATER RESOURCES PERSONNEL: A PILOT STUDY, Parts 1 and 2,
Surveys and Research Corp., Washington, D.C.
Jacob Fisher.
Both parts available from the Clearinghouse as PB-189 045 (Pt 1) + PB 189 046 (Pt 2) $3.00 in paper copy, or $0.65 in microfiche. Report, Surveys and Research Corporation, Dec 31, 1969. Part 1, 189 p; Part 2, tables and append. OWRR Project C-1414.

Descriptors: *Manpower, *Labor supply, Occupations, Professional personnel, *Scientific personnel, Universities, *Training.
Identifiers: *Position characteristics, Position responsibility level, Position functions, Position requirements, Personnel demnd (Vacancies), Manpower demand forecasts, University faculty discipline identification.

The study was undertaken to test a methodology for obtaining measures of the supply of and demand for trained water resources personnel. The report presents the findings of three research projects: (1) a mail survey of 127 employing organizations selected to be illustrative of establishments employing trained water resources personneli in State and local governments, regional agencies, industry, engineering services, and non-profit organizations; (2) a mail survey of 17 universities with water resources institutes or engaged in teaching and research in water resources; and (3) a study of the employment of trained water resources personnel in the Federal government, based on interviews, correspondence, and examination of selected records. In the opinion of the survey staff, the methodological test successfully demonstrated the feasibility of a full-scale study of the subject. Recommendations are made on the scope and character of such a study, including sample size and data to be obtained.
W70-03038

10. SCIENTIFIC AND TECHNICAL INFORMATION

SOME ASPECTS OF THE SCIENTIFIC COMMUNICATION SYSTEM IN HYDROLOGY,
Department of Energy, Mines, and Resources (Ontario).
P. Meyboom.
Groundwater, Vol 7, No 4, p 28-37, July-Aug 1969. 10 p, 3 fig, 7 tab, 18 ref.

Descriptors: *Hydrology, *Publications, *Documentation, *Reviews, *Technical writings, Editing, Half life, Information retrieval, Bibliographies, Hydrogeology, Professional personnel, Technical societies, Data transmission systems, Communication, Professional societies, Data transmission.
Identifiers: *Communication systems, *Periodicals, *Information science, Professional advancement.

The scientific communication system is defined as the sum of all publications, facilities, occasions, and institutional arrangements permitting the direct or indirect transmission of messages among scientists. The system is considered according to 3 aspects: forulating, disseminating, and obtaining the message. A review of the extensive literature written about scientific communication is given. Ever since Bernal proposed to abolish all scientific periodicals, scientists have been concerned with ways and means of better communication. And yet, in spite of the profound improvements in technology, the average scientist is as archaic as ever in his communication. The purpose of this report is to inform hydrologists of the aspects of the scientific communication system that may be relevant to their work. Discussed are general concepts in scientific communication, characteristics of some well-known journals, and ways in which messages are obtained. Sex recommendations for making the best use of the scientific communication system are included, the most important being a rationale for restrained publication. (USBR)
W70-02952

A PRELIMINARY BIBLIOGRAPHY ON EXTENT AND CAUSES OF EARLY MORTALITY

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Utah State Univ., Logan. Utah Cooperative Fishery Unit.
For primary bibliographic entry see Field 05C.
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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 3, NUMBER 9
MAY 1, 1970

W70-03244 -- W70-03646

Selected Water Resources Abstracts is published semimonthly for the Water Resources Scientific Information Center (WRSIC) by the Clearinghouse for Federal Scientific and Technical Information (CFSTI) of the Bureau of Standards, U. S. Department of Commerce. It is available to Federal agencies, contractors, or grantees in water resources upon request to: Manager, Water Resources Scientific Information Center, Office of Water Resources Research, U. S. Department of the Interior, Washington, D. C. 20240. Annual subscription is $22.00 (domestic), $27.50 (foreign), single copy price is $3.00. Certain documents abstracted in this journal can be purchased from the Clearinghouse at the prices indicated in the entry. Prepayment is required.

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SELECTED
WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

VOLUME 3, NUMBER 9
MAY 1, 1970

W70-03244 -- W70-03646

Use of funds for printing this publication approved by the Director of the Bureau of the Budget, September 4, 1968.

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

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SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

1B. Aqueous Solutions and Suspensions

LABORATORY COMPARISONS OF FRESH-WATER AND SALT-WATER WHITECAPS,
Michigan Univ., Ann Arbor. Dept. of Meteorology and Oceanography; and Northern Michigan Univ., Marquette.
Edward C. Monahan, and Carl R. Zietlow.
Journal of Geophysical Research, Vol 74, No 28, p 6961-6966, Dec 20, 1969. 6 p, 6 fig, 7 ref.

Descriptors: *Fresh water, *Sea water, *Bubbles, *Laboratory tests, Saline water, Lakes, Oceans, Ocean waves, Analytical techniques, Photography, Simulation analysis, Drops (Fluids), Waves (Water).
Identifiers: *Whitecaps (Water waves).

The bubble spectrum produced by pouring sea water differs from the fresh-water bubble spectrum in that there are relatively more bubbles with radii below 500 microns for sea water. It is therefore concluded that whitecap lifetimes should be greater on the oceans than on the lakes. Confirming laboratory whitecap simulations indicate that salt-water whitecap areas decay almost exponentially with a time constant of 3.85 seconds, whereas the decay constant for fresh-water whitecaps is 2.54 seconds. (Gabriel-USGS)
W70-03451

EXPERIMENTS ON HALINE CONVECTION INDUCED BY THE FREEZING OF SEA WATER,
Yale Univ., New Haven, Conn.
For primary bibliographic entry see Field 02C.
W70-03464

02. WATER CYCLE

2A. General

COHERENCE ANALYSIS OF STATIONARY PROCESSES WITH APPLICATIONS TO HYDROLOGY,
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 07C.
W70-03256

A NONLINEAR APPROACH TO RUNOFF STUDIES,
College of Engineering, Madras (India).
V. C. Kulandaiswamy, and C. V. Subramanian.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 10, p 72-79, 1967. 8 p, 5 fig, 1 tab, 4 ref.

Descriptors: *Rainfall-runoff relationships, *Mathematical models, *Runoff forecasting, Computer models, Streamflow forecasting, Simulation analysis, Rainfall disposition, Unit hydrographs, Hydrograph analysis.
Identifiers: Watershed models.

The process of conversion of rainfall excess into surface runoff is studied by treating drainage basins as lumped systems. The rainfall excess is considered as inflow and the surface runoff as outflow. Making use of the equation of continuity, a differential equation used with field data indicates that the system behavior is nonlinear but can, however, be treated as linear by approximation in the case of major floods. The proposed equation is verified by applying it to observed storms, and the results are found to be very encouraging. This method of approach provides considerable scope for an analytical treatment of rainfall excess-surface runoff relationship. (Knapp-USGS)
W70-03290

AN ALTERNATIVE PHYSICAL APPROACH TO WATERSHED ANALYSIS AND STREAMFLOW ESTIMATION,
New South Wales Univ., Kensington (Australia).
F. C. Bell.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 12, p 86-93, 1967. 8 p, 4 fig, 7 ref.

Descriptors: *Rainfall-runoff relationships, *Streamflow forecasting, *Routing, *Mathematical models, Water storage, Infiltration, Evaporation, Runoff, Runoff forecasting.
Identifiers: Watershed models, Infiltration theory.

The so-called 'infiltration theory' and the associated concepts of surface runoff, interflow and base flow have provided a useful but idealized physical basis for simple flood studies. These ideas are not so suitable for more comprehensive studies of watershed behavior when it is necessary to account for the detailed interrelations between evaporation, precipitation and runoff. An alternative system of watershed concepts is therefore suggested, together with a general 'retention theory' which includes infiltration theory as a special case. Retention theory provides for interrelations between hydrologic processes with mathematical expressions of 'watershed condition' and 'watershed function'. The general mathematical forms of these expressions are consistent with current physical knowledge but could be modified, if necessary, by future advances in knowledge. The specific forms of the watershed functions reflect the relevant physical characteristics of individual watersheds. Their degree of approximation or simplification in a particular problem may be governed by the nature of the problem and the amount of information available. (Knapp-USGS)
W70-03291

THRESHOLD CONSIDERATIONS AND THEIR GENERAL IMPORTANCE FOR HYDROLOGIC SYSTEMS INVESTIGATION,
Institute for Water Resources Research, Berlin (East Germany).
Alfred Becker.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 13, p 94-102, 1967. 9 p, 4 fig, 2 ref.

Descriptors: *Rainfall-runoff relationships, *Model studies, *Mathematical models, *Water storage, Rainfall disposition, Retention, Infiltration, Soil water, Groundwater, Aquifers, Recharge.
Identifiers: Watershed models.

The total water storage volume of a catchment including storage in soil and aquifers can be replaced in a model by a uniform storage layer covering the whole catchment, with storage characteristics an average of the catchment. For uniform precipitation conditions in the model catchment, threshold concepts are approximately valid. Even if rainfall distribution is known for all possible conditions, rainfall-runoff-relations generally deviate from the model catchment relations. These deviations are a measure of the hydrological inhomogeneity of the natural catchments. (Knapp-USGS)
W70-03292

FLOOD FORECASTING IN THE RIVER KITAKAMI,
Tohoku Univ., Sendai (Japan). Hydraulic Engineering Lab.
Toshio Iwasaki.
French synopsis included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 14, p 103-112, 1967. 10 p, 6 fig.

Descriptors: *Rainfall-runoff relationships, *Flood forecasting, *Model studies, *Analog models, Analog computers, Rainfall disposition, Routing, Hydrograph analysis, Unit hydrographs, Runoff forecasting.
Identifiers: *Japan, Kitakami River, Watershed models.

Most river reaches in Japan are very short compared to those in continents, and high stages appear at their downstream ends during rainfall. Flood forecasting is difficult because runoff must be estimated simultaneously with computation of the unsteady flow running down the river. Analog simulations were specially designed for this purpose. Precipitation data are recorded on punched tape. Photoelectric methods are used to convert the digital data to analog, and lag circuits of the second order are used to calculate runoff by the unit graph method. Flood forecasting was successful in the River Kitakami, and the method may be used for the flood prediction of other rivers. Total time for the calculation was only three minutes. (Knapp-USGS)
W70-03293

FLOW ROUTING BY DIRECT INTEGRATION METHOD,
Department of Energy, Mines and Resources, Toronto (Ontario). Conservation Authorities Branch.
For primary bibliographic entry see Field 02E.
W70-03294

COMPARISON OF COMPUTED AND OBSERVED FLOOD ROUTING IN A CIRCULAR CROSS-SECTION,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-03295

THE CHEMICAL AND PHYSICAL PARAMETERS IN A HYDROLOGIC TRANSPORT MODEL FOR RADIOACTIVE AEROSOLS,
Stanford Univ., Calif. Dept. of Civil Engineering.
Dale D. Huff, and Paul Kruger.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 17, p 128-135, 1967. 8 p, 15 ref. USPHS Grant ES-00047-03.

Descriptors: *Rainfall-runoff relationships, *Model studies, *Mathematical models, *Runoff forecasting, *Synthetic hydrology, Tracers, Strontium radioisotopes, Cesium, Simulation analysis, Hydrograph analysis, Aerosols, Precipitation (Atmospheric).
Identifiers: Watershed model, Cesium radioisotopes.

The Stanford Watershed Model IV has been successful in reproducing the continuous outflow hydrographs in over 40 watersheds by digital simulation of the hydrologic processes. Additions to this Model are being made to include the simulation of the transport of specific radioactive aerosols through the watershed. Subroutines for the IBM 7090 computer program are being developed to evaluate the chemical and physical parameters in the elements of hydrologic aerosol transport. A discussion of the important transport element subroutines, which include deposition, vegetal interception, soil surface interactions, and channel transport, is given for the important radiotracer elements strontium and cesium. (Knapp-USGS)
W70-03296

A PARTICULAR STOCHASTIC PROCESS AS APPLIED TO HYDROLOGY,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
Petar Todorovic, and Vujica Yevjevich.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 39, p 298-305, 1967. 8 p, 3 fig, 7 ref.

Descriptors: *Rainfall disposition, *Groundwater movement, *Bed load, *Mathematical models, *Stochastic processes, Probability, Markov processes, Synthetic hydrology, Statistical methods, Statistical models.
Identifiers: Hydrologic models (Statistical).

A particular stochastic process of nondecreasing sample functions is adjusted for application in hydrology. Three examples are discussed regarding such applications; namely, the rainfall phenomena, the groundwater diffusion problem and the movement of bedload particles. Because all three phenomena may be conceived as discrete steps of one-directional random movement of a point along a straight line, these applications meet the basic conditions for the stochastic process described. (Knapp-USGS)
W70-03301

VARIATIONS IN STATISTICAL MEASURES WITH THE LENGTH OF STREAMFLOW RECORDS,
Waterloo Univ (Ontario).
For primary bibliographic entry see Field 07C.
W70-03303

RIVER RUNOFF AS A STOCHASTIC PROCESS, AND ITS MATHEMATICAL MODELLING,
Gruzinskii Politekhnicheskii Institut, Tiflis (USSR).
G. G. Svanidze.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 43, p 329-336, 1967. 8 p, 15 ref.

Descriptors: *Runoff forecasting, *Streamflow forecasting, *Statistical methods, Probability, Markov processes, Stochastic processes, Mathematical models, Statistical models, Simulation analysis, Synthetic hydrology.
Identifiers: Watershed models.

River runoff is viewed as a stochastic process, the only realization of which is an observed hydrological series. Presented are some possible mathematical models of runoff with discrete and with continuous time. A method is here set forth for the modelling of hydrological series with the aid of orthogonal expansions. This has some advantages over the existing methods of modelling; in particular, it enables an immediate setting up of continuous realizations of runoff, under the assumption that the process is not a Markovian one. (Knapp-USGS)
W70-03304

A STOCHASTIC CONSIDERATION ON VARIATION OF HYDROLOGIC QUANTITIES,
Kyoto Univ. (Japan). Disasters Prevention Research Inst.
Mutsumi Kadoya.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 44, p 337-343, 1967. 7 p, 8 fig, 3 ref.

Descriptors: *Streamflow forecasting, *Rainfall-runoff relationships, *Statistical methods, Mathematical models, Statistical models, Stochastic processes, Markov processes, Simulation analysis, Synthetic hydrology, Time series analysis.
Identifiers: Watershed models.

A serious problem for hydraulic planning is determination of whether or not, in the sequence of hydrologic quantities, cyclic or periodic variations exist. The general character of the long-term variations in the sequences of annual sum and annual maximum of daily precipitation and of river runoff in Japan are examined using the technique of overlapping moving average. The secular variations of hydrologic quantities of short duration, such as the annual maximum daily precipitation, seem to be more random than those having the average characteristics of long duration, such as the annual sum of precipitation. The possibility or the limit of stochastic prediction for the sequential variations of hydrologic quantities by the technique of time series analysis is considered. Because the possibility of prediction is governed mainly by the power of the singular variations in the sequence, the simulation technique should be adopted in order to involve the character of secular variations of hydrologic quantities in hydraulic planning. (Knapp-USGS)
W70-03305

EVALUATION AND APPLICAON OF A DIGITAL HYDROLOGIC SIMULATION MODEL,
Clemson Univ., S.C. Water Resources Research Inst.
James T. Ligon, Albert G. Law, and Donald H. Higgins.
Available from the Clearinghouse as PB-189 290, $3.00 in paper copy, $0.65 in microfiche. Completion Report, South Carolina Water Resources Research Institute, Clemson Univ, Report No. 12, Nov 1969. 120 p, 26 fig, 1 plate, 4 tab. 12 ref, 5 append. OWRR Project A-010-SC.

Descriptors: *Hydrologic models, *Simulation, Soil moisture, Groundwater, Runoff, Infiltration, Evapotranspiration.
Identifiers: *Piedmont, *Stanford Watershed Model, Digital computer model.

A detailed analysis of the University of Kentucky version of the Stanford Watershed Model III is reported along with comparisons with Model IV. During the analysis certain errors were noted and corrected, and the source and validity of certain hydrologic functions were investigated. The model was tested on a 561-acre Piedmont watershed located near Clemson, South Carolina, for which several years of extensive hydrologic data were available. Model parameters were varied to observe their effects on model output and attempts were made to optimize these parameters. The model simulated annual stream flows quite well, monthly flows reasonably well, but daily flows and individual storm hydrographs were less satisfactory. The model as presently constituted does not incorporate a satisfactory soil moisture-groundwater relationship for this Piedmont watershed. Future studies will be concerned with improved simulation of this relationship.
W70-03436

ANALYSIS OF GROUNDWATER FLOW AND RAINFALL LOSS,
Kyoto Univ. (Japan). Disasters Prevention Research Inst.
Mutsumi Kadoya.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 24, p 177-184, 1967. 8 p, 7 fig, 6 ref.

Descriptors: *Natural recharge, *Surface-groundwater relationships, *Infiltration, Groundwater movement, Soil water movement, Evapotranspiration, Water loss, Runoff, Rainfall-runoff relationships.
Identifiers: Japan.

A theoretical method for the estimation of the groundwater flow and the rainfall loss in a small mountain stream is described. There is a simple relation between the infiltration capacity and the soil-moisture ratio in the surface layer of a drainage basin, defined by the saturated soil-moisture ratio, the hygroscopic coefficient, and the upper and lower limits of infiltration capacity. The equation derived for the infiltration capacity can be used for the recharge capacity. Recharge of groundwater occurs only if the soil-moisture ratio in the surface layer equals or exceeds the maximum capillary water capacity. A simple relation exists between the evapotranspiration and the soil-moisture ratio in the surface layer of the basin. The depth of an imaginary surface layer related to the recharge capacity equals the actual depth related to evapotranspiration. (Knapp-USGS)
W70-03489

PALEOHYDROLOGY: APPLICATION OF MODERN HYDROLOGIC DATA TO PROBLEMS OF THE ANCIENT PAST,
Colorado State Univ., Fort Collins. Dept. of Geology; and Geological Survey, Fort Collins, Colo.
S. A. Schumm.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 25, p 185-193, 1967. 9 p, 4 fig, 1 tab, 22 ref.

Descriptors: *Paleohydrology, *Rivers, *Runoff, *Sedimentation, Regime, Rainfall, Vegetation effects, Floods, Sediment yield, Surface waters, Weathering, Erosion, Climates, Weather.

The relationships between precipitation, temperature, runoff, and sediment yield can be used to theorize on the manner in which ancient rivers responded to modification of their hydrologic regimen due to climate change. During the last few million years of earth history, vegetation was much as it is today within a given climatic environment, and the hydrologic relationships of the present can be applied directly to this portion of geologic time. However, when the surface of the earth was a phytological desert, that is, before the appearance of land vegetation and also during the colonization of the earth's surface by evolving vegetation, the character of the surface water portion of the hydrologic cycle would have been very different from that of the present. Great floods must have been more frequent with sediment yield rates being limited only by the erodibility and weathering characteristics of rocks. It is suggested herein that the hydrologist can contribute to a better understanding of these past environments and, thereby, to the solution of some puzzling geologic problems. (Knapp-USGS)
W70-03490

THE SIMULATION OF INFILTRATION FOR STUDIES IN OVERLAND FLOW,
Melbourne Univ., Parkville (Australia). Dept. of Agricultural Engineering.
G. A. Jobling, and A. K. Turner.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 27, p 203-210, 1967. 8 p, 7 fig, 3 ref.

Descriptors: *Rainfall-runoff relationships, *Overland flow, *Model studies, *Hydraulic models, *Simulated rainfall, Simulation analysis, Artificial precipitation, Rainfall simulators, Runoff forecasting, Routing.
Identifiers: Watershed models.

'Overland flow' over natural surfaces is unsteady and spatially varied, due to both rainfall and infiltration. Most experimental work to date has been done using impermeable surfaces, the effects of time-dependent infiltration being ignored. Research into flows over natural surfaces is time consuming and the results are difficult to interpret at this stage in our knowledge of such flows. A method of simulating infiltration is described which enables experimental work to be undertaken in a tilting flume. The system produces a time-dependent decay in simulated infiltration, and can be described by an equation of the form used by Kostiakov. Since the two parameters involved can be readily altered, the system provides a means of simulating a range of field surfaces. Some initial results using the method are described. (Knapp-USGS)
W70-03492

THE RECOVERY OF THE INFILTRATION CAPACITY AFTER DRAINAGE,
Cornell Univ. Ithaca, N.Y.
For primary bibliographic entry see Field 02G.

W70-03495

SIMULATION OF RUNOFF FOR DESIGN OF WATER RESOURCE SYSTEMS,
State Water Plan Development of Water Resources Management, Prague (Czechoslovakia).
Zdenek Kos.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 37, p 283-289, 1967. 7 p, 4 ref.

Descriptors: *Streamflow forecasting, *Water management (Applied), *Mathematical models, *Probability, *Stochastic processes, Markov processes, Reservoir yield, Multiple-purpose reservoirs.
Identifiers: *Watershed planning.

Stochastic hydrology is successful in forecasting stremflow, especially with the aid of electronic digital computers. The method of generation of synthetic hydrologic records used in Czechoslovakia is described. Simulation studies are made for yearly flows in order to determine the overyear component of active reservoir capacity required for a specified level of draft and for monthly flows to determine its seasonal component and for the design of multiunit, multipurpose water resources systems. (Knapp-USGS)
W70-03496

SOME MEASUREMENTS OF THE TRITIUM CONTENT IN THE NATURAL WATER OF SOUTHERN OAHU, HAWAII,
Hawaii Univ., Honolulu. Water Resources Research Center.
Theodorus H. Hufen, Robert A. Duce, and L. Stephen Lau.
Available from the Clearinghouse as PB-189 406, $3.00 in paper copy, $0.65 in microfiche. Technical Report No 34, Completion Report, Hawaii Water Resources Research Center, Nov 1969. 32 p. OWRR Project A-016-HI.

Descriptors: *Tritium, *Hawaii, Rainwater, Groundwater.
Identifiers: *Oahu (Hawaii).

An analysis was made of the tritium content of samples from various sources of surface and subsurface waters of the island of Oahu. Twenty rainwater samples collected from various rain gages located on the Koolau Range over a period of four months showed an activity between 16.3 and 28.2 tritium units. Samples from four streams in the Pearl Harbor area ranged from 14.5 to 21.3 tritium units, while samples from two springs and five wells in this same area all showed an activity below 5 tritium units. The instrumentation consisted of an electrolysis enrichment apparatus, a vacuum distillation unit and a liquid scintillation counter. A detailed description is given of the various parts of the electrolysis apparatus and the vacuum distillation unit. Both the enrichment and counting procedures are reviewed as well as the calibration of these systems.
W70-03613

A MICROCLIMATIC PROFILE BETWEEN THE SNAKE RIVER CANYON AND CLEARWATER MOUNTAINS, IDAHO,
Idaho Univ., Moscow. Water Resources Research Inst.
For primary bibliographic entry see Field 02B.
W70-03645

2B. Precipitation

A RAINFALL RATE SENSOR,
Coast and Geodetic Survey, Rockville, Md.
For primary bibliographic entry see Field 07B.
W70-03363

GENERALIZING DRY-DAY FREQUENCY DATA,
Agricultural Research Service, Beltsville, Md. Hydrograph Lab.
David M. Hershfield.
Journal of American Water Works Association, Vol 62, No 1, p 51-54, Jan 1970. 4 p, 6 fig, 4 tab, 5 ref.

Descriptors: *Probability, *Droughts, *Precipitation (Atmospheric), Weather, Climates, Forecasting, Statistical methods, Weather forecasting, Estimating, Frequency analysis.
Identifiers: Dry-day sequences, Dry-day forecasting.

A statistical procedure is presented for calculating the probability of dry-day sequences up to 20 days in length. Mean annual dry period frequencies, probabilities, and lengths in the eastern and central U. S. are shown on maps. The procedure requires information on the mean annual number of days with precipitation above a selected threshold. Use of the cumulative form of the geometric distribution as given will provide the probability, P, of obtaining a dry period of a particular length, k. For rarer return periods (longer dry periods), say, greater than 20 days, the extreme-value procedure appears to be satisfactory. (Knapp-USGS)
W70-03441

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS,
Texas A and M Univ., College Station. Dept. of Meteorology.
Walter K. Henry, John F. Griffiths, L. Glen Cobb, and David Morris.
US Army Electronics Command Research and Development Technical Report ECOM-02313-S2, Oct 1967. 169 p, 58 fig. Contract No DA 28-043 AMC-2313 (E), DA Proj No 1VO-14501-B-53A-09-04.

Descriptors: *Rainfall, *Rainfall disposition, *Weather patterns, *Meteorology, Climatology, Precipitation (Atmospheric), Storms, Synoptic analysis, Tropical cyclones, Weather.
Identifiers: *Tropical rainfall, South America.

The rainfall pattern, the seasonal changes of rainfall, the variation of rainfall, and an analysis of the areal coefficient of association of rainfall were studied in Guayana and Surinam. Some movement of rains to the south were observed in Colombia (about 20 miles per day). A study of daily rainfall in interior Colombia included establishing the size and location of principle mesoscale systems on individual days. The method of extreme value distribution has been applied to some rainfall data from Venezuela. The analysis shows that in nearly all cases it is possible to use the asymptotic distribution. A method of areal presentation is derived and presented. The general problem of rainfall trends is investigated by the use of the single-runs test and simple linear regression. No significant trends for stations in Guayana and Surinam were found. Excellent correlation exists between occurrences of high sea temperatures in Peru (El Nino phenomena) and excessive rainfall. A zonification according to seasonal distribution of rainfall provides information about existing regions of uniform distribution and the approximate position of the intertropical convergence zone across Western Colombia. Associations of annual rainfall were generally low, with only a few limited areas displaying moderate to high association values. (Knapp-USGS)
W70-03479

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS: PART A. RAINFALL PATTERNS IN GUAYANA AND SURINAM,
Texas A and M Univ., College Station. Dept. of Meteorology.
Walter K. Henry.
US Army Electronics Command Research and Development Technical Report ECOM-02313-S2, p 1-13, Oct 1967. 13 p, 7 fig.

Descriptors: *Rainfall, *Rainfall disposition, *Weather patterns, *Meteorology, *Synoptic analysis, Climatology, Precipitation (Atmospheric), Storms, Tropical cyclones, Weather.
Identifiers: *Guayana, *Tropical rainfall.

The rainfall patterns of Guayana and Surinam are complex. However, the terrain is not as much of a cause of the rainfall variation as in other areas. The variations from station to station are pronounced as shown by all criteria. Also, the synoptic feature which causes the December rains along the coast does not extend its effects more than 200 miles inland. (Knapp-USGS)
W70-03480

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS: PART B. MOVEMENT OF MESOSCALE SYSTEMS IN COLOMBIA,
Texas A and M Univ., College Station. Dept. of Meteorology.
Walter K. Henry.
US Army Electronics Command Research and Development Technical Report ECOM-02313-S2, p 14-20, Oct 1967. 7 p, 3 fig.

Descriptors: *Rainfall, *Rainfall disposition, *Weather patterns, *Meteorology, *Synoptic analysis, Climatology, Precipitation (Atmospheric), Storms, Tropical cyclones, Weather.
Identifiers: *Colombia, *Tropical rainfall.

An attempt to trace the movements of rainstorms in Colombia by using three-day running totals of daily rain was partially successful. Rainy periods were well identified. In a few cases, movement toward the south was identified and a rate of about 20 miles a day established. This rate is about the same as was established by previous investigations. From the differing amounts of rainfall, it is apparent that the systems were not active at all times. (Knapp-USGS)
W70-03481

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS: PART C. DAILY RAINFALL IN INTERIOR COLOMBIA,
Texas A and M Univ., College Station. Dept. of Meteorology.
Walter K. Henry.
US Army Electronics Command Research and Development Technical Report ECOM-02313-S2, p 21-37, Oct 1967. 17 p, 11 fig, 1 tab.

Descriptors: *Rainfall, *Rainfall disposition, *Weather patterns, *Meteorology, *Synoptic analysis, Climatology, Precipitation (Atmospheric), Storms, Tropical cyclones, Weather, Topography.
Identifiers: *Colombia, *Tropical rainfall.

The rainfall patterns in interior Colombia are greatly influenced by the rugged terrain. A study of daily rainfall was made in the month of April 1962. April is the beginning of the rainy season. It was selected so that the arrival of the rains could be observed. The entire area had only scattered light showers between the 7th and the 18th. From the 18th to the end of the month there was only one day which at least half the stations did not receive some rain. On the 21st, which was the rainiest day, 12 stations did not receive any rain. The stations in wide valleys receive much less rain than do those on the mountain sides. In narrow valleys the system is large enough to extend over, or even across, the valley. Mesoscale systems are smaller on the Bogota plateau than in the lowlands. If a systematic movement of mesoscale systems exist in the mountain areas of Colombia, it has not yet been identified. (Knapp-USGS)
W70-03482

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS: PART D. NORMALITY OF RAINFALL DISTRIBUTIONS,
Texas A and M Univ., College Station. Dept. of Meteorology.
John F. Griffiths.
US Army Electronics Command Research and Development Technical Report ECOM-02313-S2, p 38-67, Oct 1967. 30 p, 4 fig, 3 tab.

Descriptors: *Rainfall, *Rainfall disposition, *Weather patterns, *Meteorology, *Synoptic analysis, Statistical methods, Climatology, Precipitation (Atmospheric), Storms, Tropical cyclones, Weather, Topography.
Identifiers: *Guayana, *Surinam, *French Guiana, Tropical rainfall.

About 90% of the station rainfall data in Guayana, Surinam, and French Guiana exhibit a square-root-normal distribution while about the same percentage exhibit a normal distribution of annual amounts. Areal analysis of non-normally distributed station-months may provide important clues to regions which should receive special synoptic studies. In general, normality (of absolute numbers or their square roots) of the data may be assumed but there are groups of abnormal stations near New Amsterdam and Paramaribo. (Knapp-USGS)
W70-03483

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS: PART E. EXTREME VALUE ANALYSIS IN VENEZUELA,
Texas A and M Univ., College Station. Dept. of Meteorology.
John F. Griffiths.
US Army Electronics Command Research and Development Technical Report ECOM-02313-S2, p 68-81, Oct 1967. 14 p, 8 fig, 1 tab.

Descriptors: *Rainfall, *Rainfall disposition, *Weather patterns, *Meteorology, *Synoptic analysis, Statistical methods, Climatology, Precipitation (Atmospheric), Storms, Tropical cyclones, Weather, Topography.
Identifiers: *Venezuela, *Extreme value analysis, Tropical rainfall.

An extreme value analysis was made of the records from 15 stations in Venezuela. For these stations the highest amount of daily rainfall recorded in each month for the whole period of record was extracted. Some of the extremely high values are rather dubious; comparison with neighboring stations gives rise to a suspicion that the value given for one day is actually a composite of many days. For each month for each station, plots were made of the resulting points on extreme probability graph paper. Lines of best fit were then drawn for these points and from the resulting line the values of the precipitation corresponding to the 0.30 and 0.90 probability levels were extracted. Extreme (30% and 90% values are tabulated and shown by contour maps. (Knapp-USGS)
W70-03484

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS: PART F. TRENDS IN THE RAINFALL,
Texas A and M Univ., College Station. Dept. of Meteorology.
John F. Griffiths.
US Army Electronics Command Research and Development Technical Report ECOM-2313-S2, p 82-86, Oct 1967. 5 p, 3 tab.

Descriptors: *Rainfall, *Rainfall disposition, *Weather patterns, *Meteorology, *Synoptic analysis, Statistical methods, Climatology, Precipitation (Atmospheric), Storms, Tropical cyclones, Weather
Identifiers: *Venezuela, *Tropical rainfall.

Swed-Eisenhart and linear regression analyses were used to test for long term precipitation and climatic trends in the Guianas. Except for 2 stations with possible trends, no trends could be found. For Guayana and Surinam, no trends are shown by the statistical analyses. (Knapp-USGS)
W70-03485

RESEARCH ON TROPICAL RAINFALL PATTERNS AND ASSOCIATED MESOSCALE SYSTEMS: PART H. AN ANALYSIS OF THE DISTRIBUTION OF RAINFALL AND SOME RAINFALL ASSOCIATIONS FOR SELECTED STATIONS IN WESTERN COLOMBIA,
Texas A and M Univ., College Station. Dept. of Meteorology.
David G. Morris.
US Army Electronics Command Research and Development Technical Report ECOM-2313-S2, p 104-155, Oct 1967. 52 p, 26 fig, 1 tab, 16 ref, append.

Descriptors: *Rainfall, *Rainfall disposition, *Weather patterns, *Meteorology, *Synoptic analysis, Statistical methods, Climatology, Precipitation (Atmospheric), Storms, Tropical cyclones, Weather.
Identifiers: *Colombia, *Tropical rainfall.

The seasonal distribution of rainfall is uniform within broad, well defined areas of Western Colombia. The map of mean annual rainfall shows definite synoptic-scale patterns in some areas, with the most significant being the Pacific western coast and the eastward intrusion across the northern terminus of the Cordilleras. The variability of annual totals is generally greatest in higher, drier elevations, with lower areas showing standard deviations on the order of 200 mm and 400 mm. Rainfall variability increases or decreases greatly over small distances in rugged terrain. Generally, there is little association in the annual rainfall except in small areas. Relatively small changes in topography greatly alter the rainfall patterns. Rainfall patterns east of the Cordillera Occidental are not associated with the rains of the Pacific west coast. (Knapp-USGS)
W70-03486

SOME MEASUREMENTS OF THE TRITIUM CONTENT IN THE NATURAL WATER OF SOUTHERN OAHU, HAWAII,
Hawaii Univ., Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 02A.
W70-03613

A MICROCLIMATIC PROFILE BETWEEN THE SNAKE RIVER CANYON AND CLEARWATER MOUNTAINS, IDAHO,
Idaho Univ., Moscow. Water Resources Research Inst.
Richard L. Day.
Available from the Clearinghouse as PB-189 402, $3.00 in paper copy, $0.65 in microfiche. Idaho Univ Water Resources Res Inst Tech Completion Rep, Sept 1968. 68 p, 30 fig, 3 tab, 1 append. OWRR Proj No A-012-IDA.

Descriptors: *Climatology, *Microclimatology, *Micrometeorology, *Idaho, *Precipitation (Atmospheric), Temperature, Humidity, Meteorology, Storms, Topography, Weather, Weather data, Data collections.
Identifiers: *Snake River Canyon (Idaho), Clearwater Mountains (Idaho).

Temperature and relative humidity records have been kept at a maximum of 18 sites, and precipitation records at 8 sites, along a 75-mile profile between Wawawai, Washington, elevation 675 ft in the Snake River Canyon, and Crater Peak, elevation 6400 ft in the Clearwater Mountains, Idaho. The most distinctive microclimatic feature is the extreme development of nocturnal temperature inversions during summer and early autumn. Mean inversions between non-contiguous hilltops and bottomlands may reach 20 to 30 deg. Greatest recorded on a specific day has been 42 deg. Mean temperatures, length of frost-free season, nocturnal relative humidities, natural vegetation, and land use are all strongly influenced by these inversions. None of the 6 official Weather Bureau stations in the vicinity of the profile is located to show these inversions. Diurnal temperature and relative humidity patterns differ greatly at individual sites along the profile and are analyzed and compared. Precipitation normally varies by a factor of at least 3 1/2 along the profile, but may reach several times this value during individual months. Maximum snow depths range from none at Wawawai to 14 ft at Lost Lake near Crater Peak during specific snow seasons. (Knapp-USGS)
W70-03645

2C. Snow, Ice, and Frost

VARIATION IN THE MEAN DEUTERIUM CONTENT OF PRECIPITATIONS IN ANTARCTICA,
Centre National de la Recherche Scientifique, St. Cloud (France).
C. Lorius, L. Merlivat, and R. Hagemann.
Journal of Geophysical Research, Vol 74, No 28, p 7027-7031, Dec 20, 1969. 5 p, 2 fig, 1 tab, 10 ref.

Descriptors: *Deuterium, *Precipitation (Atmospheric), *Antarctic, *Firn, Air temperature, Sampling, Mapping, Stations, Snow, Altitude, Coasts, Meteorological data.
Identifiers: Antarctica.

Firn samples taken at the Adelie Coast, Victoria Land, and Marie Byrd Land of Antarctica were analyzed for their deuterium content and the results are tabulated. The mean isotopic content of snow samples is generally associated with the mean annual temperature prevailing at the place where precipitation occurs. (Gabriel-USGS)
W70-03461

EXPERIMENTS ON HALINE CONVECTION INDUCED BY THE FREEZING OF SEA WATER,
Yale Univ., New Haven, Conn.
Theodore D. Foster.
Journal of Geophysical Research, Vol 74, No 28, p 6967-6974, Dec 20, 1969. 8 p, 9 fig, 1 tab, 9 ref. ONR Contract No N00014-67-A-0097-0001.

Descriptors: *Sea water, *Salinity, *Convection, *Freezing, *Density currents, Laboratory tests, Mathematical studies, Thermal conductivity, Diffusion, Mixing, Analytic techniques, Instrumentation, Cooling, Water temperature, Currents (Water), Photography, Eddies.
Identifiers: Haline convection.

Laboratory experiments were performed in which sea water was frozen from above at controlled rates. The resulting haline convection was observed by using a schlieren optical system. Salinity of the sea water was varied from about 20 to 35 parts per thousand. Freezing rates up to about 0.00015 g/sq cm sec were used. The resultant salt fluxes varied from about 0.0000002 to 0.000002 g/sq cm sec. The haline convection took the form of long vertical filaments with a horizontal spacing of 0.2 to 0.3 cm, in good agreement with the predictions of linear theory. (Gabriel-USGS)
W70-03464

2D. Evaporation and Transpiration

ACTUAL EVAPOTRANSPIRATION AS DETERMINED FROM SOIL-WATER AND CANOPY CHARACTERISTICS AND POTENTIAL EVAPOTRANSPIRATION,
Wisconsin Univ., Madison. Dept. of Soil Science.
T. A. Black, C. B. Tanner, and W. R. Gardner.
Available from the Clearinghouse as PB-184 791, $3.00 in paper copy, $0.65 in mress Report to Environmental Science Services Administration from

Wisconsin University, May 1969. 42 p, 9 fig, 1 tab, 28 ref. ESSA Grant E-287-68 (G).

Descriptors: *Evapotranspiration, *Water loss, *Drainage, Water balance, Hydrologic budget, Darcys law, Infiltration, Evaporation, Runoff, Lysimeters, Soil-water-plant relationships, Soil water movement, Water storage.
Identifiers: Potential evapotranspiration, Soil water evaporation.

Water loss from soils supporting vegetation is due to either evapotranspiration or drainage. Means of calculating both of these components of the hydrologic balance were investigated using primary climate, soil, and plant parameters. Evapotranspiration was found by treating separately the processes of transpiration from vegetation and evaporation from the soil. The model was tested on a snap bean crop in which two drying cycles restricted evapotranspiration severely. The calculated evapotranspiration was 102 mm whereas 98 mm was measured. As much as 30% relative error was found when the soil was dry, but the absolute error was only 0.3 mm. Inaccuracy was due mainly to inaccurate estimates of evaporation from the soil. Drainage from the root zone of the snap beans grown on a sandy soil was measured in three ways: by Darcy's law, by a lysimeter, and by the hydrologic balance. Darcy's law gave a 13% higher estimate than the other two methods, which agreed well with each other. (Knapp-USGS)
W70-03449

2E. Streamflow and Runoff

UNIVERSAL FORMULA FOR UNIFORM FLOW,
Tennessee Valley Authority, Norris. Engineering Lab.
For primary bibliographic entry see Field 08B.
W70-03248

LONGITUDINAL SLOPE CHARACTERISTICS OF RIVERS OF THE MIDCONTINENT AND THE ATLANTIC EAST GULF SLOPES,
Geological Survey, Washington, D.C.
Charles W. Carlston.
Bulletin of the International Association of Scientific Hydrology, Vol 14, No 4, p 21-31, Dec 1969. 11 p, 4 fig, 4 ref.

Descriptors: *Channel morphology, *Profiles, *Mississippi River, *Missouri River, *Ohio River, Geomorphology, Erosion, Sedimentation, Regime, Terracing, Channels, Beds.
Identifiers: River profiles.

Study of longitudinal stream profiles of rivers of the Midcontinent (rivers tributary to the Mississippi) and Atlantic and East Gulf Slopes has revealed five types of longitudinal profiles: (1) Overall concave-upward profiles with or without long constant slope segments; (2) convex upward (the Missouri River has a profile that has a constant slope for its lower 560 miles and then is convex upward to a point beyond the Yellowstone River junction); (3) concave-upward irregular, ungraded, low-gradient profiles (Ohio and Tennessee Rivers); (4) irregular unsegmented and steep profiles, such as shown by the Delaware and Savannah-Tugaloo Rivers; and (5) irregular ungraded, steep-gradient profiles that are concave-upward in the upstream reaches and downstream convex-upward, for example, on most of the Atlantic Slope and East Gulf Slope Rivers above the Fall Line. Constant slope profiles occur where the last type of rivers flow across relatively weak Coastal Plain sediments and also inland on the Coosa and Oostanaula-Conasauga Rivers. The profile characteristics of the Atlantic and East Gulf streams lend support to the hypothesis of multiple erosion cycles in the Appalachians. (Knapp-USGS)
W70-03255

FLOOD PLAIN INFORMATION, BLACK CREEK AND GENESEE RIVER IN THE TOWNS OF CHILI AND RIGA, MONROE COUNTY, NEW YORK.
Corps of Engineers, Buffalo, N.Y.
For primary bibliographic entry see Field 04A.
W70-03261

REDUCTION OF SERIALLY CORRELATED HYDROLOGIC DATA,
Pittsburgh Univ., Pa. Dept. of Civil Engineering.
For primary bibliographic entry see Field 07C.
W70-03263

FLOOD PLAIN INFORMATION, FLATHEAD, STILLWATER AND WHITEFISH RIVERS, KALISPELL - COLUMBIA FALLS, MONTANA.
Corps of Engineers, Seattle, Wash.
For primary bibliographic entry see Field 04A.
W70-03272

FLOOD PLAIN INFORMATION, TIDAL AREAS OF PALM BEACH COUNTY, FLORIDA.
Corps of Engineers, Jacksonville, Fla.
For primary bibliographic entry see Field 04A.
W70-03273

MINERAL AND WATER RESOURCES OF ARIZONA: PART 2. WATER RESOURCES; AND PART 3. WATER RESOURCE DEVELOPMENT,
Geological Survey, Tucson, Ariz.; and Bureau of Reclamation, Phoenix, Ariz.
J. J. Ligner, Natalie D. White, L. R. Kister, and M. E. Moss.
Report available for sale by Arizona State Bur of Mines, Ariz Univ, Tucson, Ariz- Price $3.00. Arizona State Bureau of Mines Bulletin 180, p 469-638, 1969. 170 p, 34 fig, 38 tab, 108 ref.

Descriptors: *Water resources, *Groundwater, *Surface waters, *Water supply, *Arizona, Water yield, Water utilization, Irrigation water, Overdraft, Water levels, Streamflow, Water level fluctuations, Withdrawal, Reservoirs, Reservoir yield, Hydroelectric power, Data collections, Hydrologic data, Water rights.
Identifiers: Water availability (Ariz).

Factual information about Arizona's present water supplies and supplies available for future exploitation is compiled in a summary of the State's mineral and water resources. The physical environment and water provinces of the State are described, followed by descriptions of the water resources under each respective water province, by province subdivision, or area. Summary information is presented in maps, graphs, and tables. Also included are brief sections that present discussions of the potential waterpower, and geothermal resources. Water resource developments and potential water resource developments, water conservation practices, and various research programs on water conservation are discussed. (Knapp-USGS)
W70-03278

MEAN STREAMFLOW FROM DISCHARGE MEASUREMENTS,
Geological Survey, Washington, D.C.
H. C. Riggs.
Bulletin of the International Association of Scientific Hydrology, Vol 14, No 4, p 95-110, Dec 1969. 16 p, 12 fig, 6 tab, 3 ref.

Descriptors: *Streamflow, *Average flow, *Stream gages, *Discharge measurement, *Estimating, Statistical methods, Gaging stations, Rainfall-runoff relationships, Runoff, Hydrographs, Routing, Stage-discharge relations, Data processing.
Identifiers: Streamflow estimating.

Mean flow of a stream is usually computed from a continuous record of flow at a gaging station. A less costly method consists of (1) estimating 12 individual monthly flows from one discharge measurement per month and a concurrent gaging station record on a nearby stream, using a different relation for each month, (2) computing the annual mean from the estimated monthly means, and (3) using a relation based on gaging station records to estimate the long-term mean from the one annual mean. An annual mean can be estimated within about 10% of its measured value even though both the gaged and ungaged streams are affected by diversions and have different runoff characteristics. The method has greatest utility in regions where mean runoff is not closely related to drainage area. (Knapp-USGS)
W70-03280

A NONLINEAR APPROACH TO RUNOFF STUDIES,
College of Engineering, Madras (India).
For primary bibliographic entry see Field 02A.
W70-03290

AN ALTERNATIVE PHYSICAL APPROACH TO WATERSHED ANALYSIS AND STREAMFLOW ESTIMATION,
New South Wales Univ., Kensington (Australia).
For primary bibliographic entry see Field 02A.
W70-03291

FLOOD FORECASTING IN THE RIVER KITAKAMI,
Tohoku Univ., Sendai (Japan). Hydraulic Engineering Lab.
For primary bibliographic entry see Field 02A.
W70-03293

FLOW ROUTING BY DIRECT INTEGRATION METHOD,
Department of Energy, Mines and Resources, Toronto (Ontario). Conservation Authorities Branch.
J. Y. Ding.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 15, p 113-120, 1967. 8 p, 3 fig, 1 tab, 8 ref.

Descriptors: *Rainfall-runoff relationships, *Routing, *Flood routing, *Mathematical models, Hydrograph analysis, Unit hydrographs, Overland flow, Water storage, Infiltration, Open channel flow.
Identifiers: *Kinematic wave theory, Watershed models.

A flow routing equation is developed from the continuity equation in the form of the hydrologic equation and a simplified dynamic equation expressed by a general storage-discharge relation. Flow routing thus becomes the solution of kinematic-wave problems. The solution of the routing equation is simplified by using the table of the varied-flow functions, F (u,n), where n is the storage exponent and u is the n-th root of the ratio of outflow to inflow. When inflow is zero, the routing equation can be linearized. For a number of storage elements, the value of the storage exponent, n, is found to vary from 1/2 for orifice to 3 for laminar overland flow. Examples of flow routing are given, with emphasis on Izzard's overland flow hydrographs. It is shown that Izzard's dimensionless hydrograph can be derived from the condition of unsteady laminar varied flow. Several concepts in hydrology are derived mathematically from the routing equation, and a critique of routing methods is presented. (Knapp-USGS)
W70-03294

COMPARISON OF COMPUTED AND OBSERVED FLOOD ROUTING IN A CIRCULAR CROSS-SECTION,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
Albert H. Barnes.

French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 16, p 121-127, 1967. 7 p, 3 fig, 1 tab, 2 ref.

Descriptors: *Flood routing, *Rainfall-runoff relationships, *Storm drains, *Closed conduit flow, Rational formula, Mathematical models, Digital computers, Simulation analysis, Drainage systems.
Identifiers: Drainage system design.

The numerical solution to the dynamic equations representing unsteady flow have been compared with experimentally observed values taken from a carefully conducted experiment and found to compare favorably within the range of observations. A numerical solution to the hyperbolic partial differential equations expressed unsteady flow, commonly referred to as flood routing, has been accomplished in several different ways. The method utilizing a second-order interpolation commonly referred to as the Lax-Wendroff method, has produced the most nearly stable results. The method of characteristics and the diffusing method of numerical integration have been investigated and have shown to offer no advantage over the Lax-Wendroff method. Experimental observations were conducted in a 3-ft diameter pipe, 822-ft long, with discharges ranging from approximately 5 cfs to approximately 70 cfs, with hydrographs of one to two-min durations. Depth hydrographs were observed at 6 points along the conveyance channel and computed for the same positions. Agreement between computed and observed was within about 5 percent in general. The developed numerical procedure and the digital computer will not provide a basis for improved design of storm drainage systems. (Knapp-USGS)
W70-03295

VARIATIONS IN STATISTICAL MEASURES WITH THE LENGTH OF STREAMFLOW RECORDS,
Waterloo Univ (Ontario).
For primary bibliographic entry see Field 07C.
W70-03303

RIVER RUNOFF AS A STOCHASTIC PROCESS, AND ITS MATHEMATICAL MODELLING,
Gruzinskii Politekhnicheskii Institut, Tiflis (USSR).
For primary bibliographic entry see Field 02A.
W70-03304

EXTENT AND FREQUENCY OF INUNDATION ON THE PERKIOMEN CREEK FLOOD PLAIN FROM GREEN LAND RESERVOIR TO THE SCHUYLKILL RIVER (NEAR OAKS, PENNSYLVANIA),
Geological Survey, Harrisburg, Pa.
William F. Busch.
Geological Survey Open-file Report, June 1969. 27 p, 9 fig, 3 plate, 3 tab, 12 ref.

Descriptors: *Floods, *Pennsylvania, *Non-structural alternatives, Mapping, Profiles, Hydrographs, Hydrologic data, Data collections, Stage-discharge relations, Streamflow, Flood forecasting, Flood damage, Flood protection, Flood plains.
Identifiers: *Perkiomen Creek, *Oaks (Penn).

Information is presented relative to the extent, depth, and frequency of floods on Perkiomen Creek, Oaks, Pennsylvania from Green Lane Reservoir to the mouth, a reach of 20.4 miles. The depth, extent, and frequency of flooding can be estimated for any site along the reach of the Perkiomen Creek under study. Flood data and the evaluation of the data are presented so that local and regional agencies, organizations, and individuals may have a technical basis for making decisions on the use of flood-prone areas. Flood-plain inundation studies, when followed by appropriate land-use regulations, are a valuable and economical supplement to physical works for flood control. Both physical works and flood-plain regulations are included in the Comprehensive Plan for development of the Delaware River basin, of which the Perkiomen Creek is a part. (Knapp-USGS)
W70-03458

BASE-FLOW STUDIES OF LEON AND LAMPASAS RIVERS, TEXAS - QUANTITY AND QUALITY, JANUARY 16-17, 1968,
Geological Survey, Austin, Tex
Jack Rawson, and Gerald K. Schultz.
Texas Water Development Board Report 97, June 1969. 9 p, 2 fig, 2 tab, 3 ref.

Descriptors: *Base flow, *Surface-groundwater relationships, *Texas, Streamflow, Groundwater movement, Low flow, Surveys, Rivers.
Identifiers: Lampasas River (Tex), Leon River (Tex).

The purposes of base flow investigation of the Leon and Lampasas Rivers were (1) to determine the quantity of tributary inflow and the amount of interchange of surface and groundwater in the main streams, (2) to relate the nature and concentrations of dissolved constituents in the base flow to geology and to the activities of man, and (3) to evaluate the water for municipal supply, irrigation, and industrial use. Both the Leon and Lampasas Rivers generally gained flow throughout the reaches studied. Flow in the Leon River increased from 4.46 cfs at mile 16.7 to about 58 cfs at mile 0.0, a net gain of 53.5 cfs. During the study, the city of Temple diverted an average of 6.1 cfs from the Leon River. Thus, the gross gain in flow totaled 59.6 cfs. Measured inflow from tributaries was 50.9 cfs, or about 85% of the total gain in mainstream flow. Direct accretions of groundwater in the upper 4.4-mile reach of the mainstream probably accounted for much of the unmeasured gain. The dissolved-solids content of water in the Leon River increased from 253 mg/l at mile 16.7 to more than 400 mg/l. Flow in the Lampasas River increased from 24.6 cfs at mile 15.8 to 112 cfs at mile 0.1, a gain of 87.4 cfs. Measured tributary inflow was 71.5 cfs, or about 82% of the total gain. The concentration of dissolved solids in the Lampasas River decreased from 660 mg/l at mile 15.8 to 385 mg/l at mile 0.1. The base flow in streams throughout the area meets the quality requirements for irrigation and many industrial uses, but water in most streams will require softening for some industrial applications. (Knapp-USGS)
W70-03466

HYDROLOGIC STUDIES OF SMALL WATERSHEDS, COW BAYOU, BRAZOS RIVER BASIN, TEXAS, 1955-64,
Geological Survey, Austin, Tex.
Willard B. Mills.
Texas Water Development Board Report 99, Oct 1969. 66 p, 12 fig, 18 tab, 24 ref.

Descriptors: *Rainfall-runoff relationships, *Small watersheds, *Texas, Hydrographs, Runoff, Streamflow, Data collections, Hydrologic data, Water storage, Evapotranspiration, Hydrologic budget, Water balance.
Identifiers: Cow Bayou (Tex), Brazos River (Tex).

A study was made of the rainfall, inflow, consumption, and outflow for a group of 9 floodwater-detention structures on a 79.6-square-mile watershed near Bruceville, Texas for the 6 water years 1959-64. During this period annual rainfall varied from 19.18 inches in 1963 to 46.73 inches in 1961 as compared to the 32.25-inch long-term average. Total rainfall for the period 1959-64 ranged from 181.8 inches to 200.8 inches on the drainage areas of the 9 floodwater-detention structures. Runoff from these areas, total for the 6-year period, ranged from 22.2 inches to 42.7 inches. Net reduction in pool content during the period was 220 acre-feet, leaving 748 acre-feet in pool storage. A rain-gage density study for the period 1955-64 indicated that 2 rain gages installed at certain points on the watershed would provide data within 8% of the weighted mean rainfall of the 9 existing rain gages using at 67% confidence limit. An average 1-hour unit hydrograph with a 5-hour time of rise and 10,400 cfs peak was developed for the watershed (Knapp-USGS)
W70-03467

THE MECHANISM OF DIRECT SURFACE RUNOFF FROM RAINFALL,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
Charles E. Rice
Oklahoma Water Resources Research Institute. Partial Technical Completion Report, 1968. 9 p, 4 fig, 1 ref. OWRR Proj No A-006-OKLA.

Descriptors: *Rainfall-runoff relationships, *Overland flow, *Routing, *Model studies, *Hydraulic models, Laminar flow, Turbulent flow, Steady flow, Non-uniform flow, Roughness (Hydraulic).
Identifiers: Grass (Synthetic).

Studies on a synthetic grass material used to simulate a natural vegetation for overland flow conditions show that two regimes of flow occur, one occurring when the flow depth is less than the height of the grass (assumed as laminar flow) and another occurring when the flow depth is greater than the height of the grass (turbulent flow). Because the synthetic grass occupied a considerable portion of the flow depth the physical bottom was assumed as not being representative of the effective bottom. Thus, for turbulent flow an effective bottom was found as the intercept when water surface elevation was plotted versus discharge to the 0.6 power. The Manning coefficient for the turbulent flow range increased slightly with discharge and its value (average of about 0.032) indicated that the synthetic grass had a high retardance to the flow of water. (Knapp-USGS)
W70-03475

RELATION OF DISCHARGE AND STREAM LENGTH IN EASTERN UNITED STATES,
Antioch Coll., Yellow Springs, Ohio. Dept. of Earth Sciences.
Marie E. Morisawa.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 23, p 173-176. 4 p, 2 tab.

Descriptors: *Streamflow forecasting, *Correlation analysis, *Terrain analysis, Channel morphology, Geomorphology, Runoff forecasting, Statistical methods, Water yield, Discharge (Water).
Identifiers: *Stream length, *Drainage basin morphology.

Correlation of longest stream length and mean annual discharge for 96 watersheds in six different physiographic regions of eastern United States results in correlations indicating that for each region one variable is highly related to the other. The relationship between the two variables is significantly different from region to region; one general equation determined from all data cannot be used for individual regions. However, the statistical validity of the correlations does supply an empirical method which can be used to estimate mean annual discharge in ungaged watersheds within a given region. (Knapp-USGS)
W70-03487

PALEOHYDROLOGY: APPLICATION OF MODERN HYDROLOGIC DATA TO PROBLEMS OF THE ANCIENT PAST,
Colorado State Univ., Fort Collins. Dept. of Geology; and Geological Survey, Fort Collins, Colo.
For primary bibliographic entry see Field 02A.
W70-03490

THE SIMULATION OF INFILTRATION FOR STUDIES IN OVERLAND FLOW,
Melbourne Univ., Parkville (Australia). Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 02A.
W70-03492

STOCHASTIC DESCRIPTION OF DAILY RIVER FLOWS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
Rafael G. Quimpo.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 38, p 290-297, 1967. 8 p, 2 fig, 3 tab, 13 ref. NSF Grant GK-169.

Descriptors: *Streamflow forecasting, *Statistical methods, *Correlation analysis, *Stochastic processes, *Markov processes, *Mathematical models, Probability, Time series analysis, Frequency analysis, Synthetic hydrology, Fourier analysis.
Identifiers: Spectral analysis.

A mathematical representation for series of daily streamflows is postulated. The model is made up of a periodic and a stochastic component. The periodic component is applied both to 365 mean daily flows and to 365 standard deviations about these means. Five rivers are used to show the method of approach. First, periodic components were detected, in the daily means, and in standard deviations and isolated by using spectral analysis. Then, autoregressive schemes were fitted to stationary stochastic series after the periodic components had been removed. Finally, stochastic components of these series for all five rivers were found to be well fitted by the second order Markov linear model. (Knapp-USGS)
W70-03497

ENTRAINMENT PRINCIPLE AND ITS RESTRICTIONS TO SOLVE PROBLEMS OF JETS,
Waterloopkundig Laboratorium, Delft (Netherlands).
For primary bibliographic entry see Field 08B.
W70-03545

2F. Groundwater

HYDROLOGIC RECONNAISSANCE OF THE BEAR RIVER BASIN IN SOUTHEASTERN IDAHO,
Geological Survey, Boise, Idaho.
N. P. Dion.
Idaho Department of Reclamation Water Information Bulletin No 13, Oct 1969. 66 p, 14 fig, 7 tab, 22 ref.

Descriptors: *Water resources, *Groundwater, *Idaho, Irrigation water, Water sources, Aquifers, Hydrogeology, Water wells, Water quality, Recharge, Water yield, Water table, Canal seepage, Seepage.
Identifiers: Bear River basin (Idaho).

The areal distribution of precipitation in the Bear River basin, Idaho is controlled chiefly by elevation, and quantities range from less than 10 inches in Bear Lake Valley to more than 45 inches on the Bear River Range. Precipitation on the basin averages about 2.3 million acre-ft per year. Groundwater occurs in the alluvium of all the valleys, the basalt of Soda Creek basin and Gem Valley, the Salt Lake Formation, the fractured bedrock, and possibly in the Wasatch Formation. The basalt and the alluvium are the most productive aquifers in the basin and are best able to withstand additional groundwater development. The basalt yields as much as 3,500 gpm and the alluvium as much as 2,500 gpm to wells. While many wells drilled into the Salt Lake Formation are nonproductive, those that are successful yield as much as 1,800 gpm. The principal sources of recharge to the aquifers include precipitation, spring snowmelt and runoff, seepage of irrigation water, and some leakage of water from Blackfoot Reservoir through the Blackfoot Lava Field into the Bear River basin. (Knapp-USGS)
W70-03254

HYDROGEOLOGY OF A VOLCANIC ISLAND CHE JU DO, KOREA,
Geological Survey of Israel, Jerusalem. Hydrogeological Div.
Yoram Eckstein.
Bulletin of the International Association of Scientific Hydrology, Vol 14, No 4, p 45-60, Dec 1969. 16 p, 9 fig, 4 tab, 12 ref.

Descriptors: *Groundwater, *Water resources, Recharge, Water levels, Basalts, Volcanoes, Permeability, Aquifers, Surveys, Water wells, Climates, Precipitation (Atmospheric).
Identifiers: Che Ju Do (Korea).

Che Ju Do is a volcanic island offshore from the Korean Peninsula. The island is an extinct volcano, petrologically a part of the intra-pacific province of the olivine-basalt-trachyte association. The last volcanic activity has been reported in old manuscripts. Climate of the island is primarily influenced by the Pacific monsoon pattern and the northwest winter Siberian winds. A highly permeable basaltic surface of the mountainous central part of the island, coincident with the highest precipitation in the area, results in good recharge of groundwater. Groundwater appears as perched horizons on impermeable planes between lava flows, but most of the reserves are stored in a basal fresh water lens, which floats upon and displaces the sea water beneath the island. (Knapp-USGS)
W70-03258

BRANCHING-TYPE MODELS OF FLOW THROUGH POROUS MEDIA,
Illinois Univ., Urbana.
K. H. Liao, and A. E. Scheidegger.
Bulletin of the International Association of Scientific Hydrology, Vol 14, No 4, p 137-145, Dec 1969. 9 p, 3 fig, 1 tab, 6 ref.

Descriptors: *Groundwater movement, *Dispersion, Flow, Porous media, Diffusion, Probability, Stochastic processes, Statistical methods, Statistical models, Model studies, Computer models, Fluid mechanics, Hydraulics.
Identifiers: Graph models, Random-graph theory.

A random-graph model is used to explain the mechanics of flow through porous media. The approach is extended to the discussion of a three-dimensional random-graph model and to an investigation of lateral dispersion in porous media. Comparisons with experimental results are given. (Knapp-USGS)
W70-03262

KARSTIC WATER RESEARCH IN HUNGARY,
Research Inst. for Water Resources Development, Budapest (Hungary). Karstic Water Research Section.
T. Bocker.
Bulletin of the International Association of Scientific Hydrology, Vol 14, No 4, p 7-20, Dec 1969. 14 p, 10 fig, 1 tab.

Descriptors: *Karst, *Groundwater movement, Water resources, Mine drainage, Water management (Applied), Reviews, Surveys, Aquifers, Water wells, Springs, Water yield, Withdrawal, Model studies, Analog models.
Identifiers: *Hungary.

Hungarian research on karst phenomena is reviewed. In Hungary, about 40% of coal production, all bauxite production, and all manganese production are from mines below the karstic water level. Mine drainage and the danger of flooding by karstic water are important subjects of research. Volumes pumped and spring flow are tabulated. Drawdown caused by pumping is mapped and briefly discussed. Model tests are used to predict effects of withdrawal. (Knapp-USGS)
W70-03264

GROUNDWATER CONDITIONS IN THE RANEGRAS PLAIN, YUMA COUNTY, ARIZONA,
Geological Survey, Phoenix, Ariz.
For primary bibliographic entry see Field 04B.
W70-03267

A STUDY ON THE RECESSION ON UNCONFINED AQUIFERS,
C. Venetis.
Bulletin of the International Association of Scientific Hydrology, Vol 14, No 4, p 119-125, Dec 1969. 7 p, 1 fig, 3 ref.

Descriptors: *Aquifers, *Drawdown, *Mathematical models, Recharge, Discharge (Water), Water level fluctuations, Groundwater movement, Water table, Withdrawal.
Identifiers: Unconfined aquifers.

The dependence of recession of the groundwater levels and groundwater discharge upon the initial state of the aquifer is examined for deep unconfined aquifers. It is shown that only in the early stages of the recession does the initial state exert a limited influence on the recession. An estimate is made of the upper limit of the time for which the recession becomes effectively independent of the initial state of the aquifer, valid for physically realistic initial states. For useful aquifers initial time cannot be expected to exceed one month. Empirical recessions often are found to be consistent and of an exponential form. (Knapp-USGS)
W70-03274

MINERAL AND WATER RESOURCES OF ARIZONA: PART 2. WATER RESOURCES; AND PART 3. WATER RESOURCE DEVELOPMENT,
Geological Survey, Tucson, Ariz.; and Bureau of Reclamation, Phoenix, Ariz.
For primary bibliographic entry see Field 02E.
W70-03278

SIMILITUDE FOR FLOW OF TWO FLUIDS IN POROUS MEDIA,
Shell Oil Co., Denver, Colo. Rocky Mountain Div.; and Colorado State Univ., Fort Collins. Dept. of Agricultural and Irrigation Engineering.
D. B. McWhorter, and A. T. Corey.
French summary included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 18, p 136-140, 1967. 5 p, 2 fig, 11 ref.

Descriptors: *Simulation analysis, *Model studies, *Synthetic hydrology, *Porous media, *Unsaturated flow, Immiscibility, Flow, Porosity, Permeability, Aquifers, Hydraulic models.
Identifiers: Similitude analysis, Multiphase flow.

Criteria of similitude are derived for systems in which two immiscible fluids move simultaneously through a porous medium as, for example, when air replaces water or water replaces air in aquifers. The similitude requirements are established by writing the combined equation of flow, and scaling this with system parameters. The system parameters are selected so that the equation of flow in terms of scaled variables provides a maximum generality and indicates criteria which are the least restrictive and which can be satisfied with laboratory models. The unique feature of this statement of the criteria of similitude (compared to those previously published) is that similitude of the media is determined by the equivalence of a single dimensionless parameter associated with pore-size distribution. The validity of the theory is demonstrated by experiments in which the behavior of similar models are compared. (Knapp-USGS)
W70-03297

GROUNDWATER RESOURCES OF ASH SHATI' AREA, KINGDOM OF LIBYA,
Geological Survey, Washington, D.C.
G. C. Tibbitts, Jr.

Geol Surv Open-file Report, July 1966. 184 p, 30 fig, 12 tab, 28 ref.

Descriptors: *Water resources, *Groundwater, *Arid lands, Artesian wells, Irrigation water, Water supply, Water wells, Water yield, Water quality, Climates, Precipitation (Atmospheric), Hydrogeology.
Identifiers: *Libya, Ash Shati, Oases, Sahara.

Flowing wells, springs, and dug wells that yield water of fair to good chemical quality supply a string of oases in Ash Shati' Libya area. The depression locally receives very infrequent runoff from ephemeral streams rising in the north, but never from the adjacent sand sea to the south. Precipitation averages about 5 mm annually, but in many years no rain falls. Sandstone of Devonian age is the important aquifer of the area, containing water of fair to good chemical quality which is confined under sufficient pressure to flow naturally at many places along Wadi ash Shati'. Contemporary recharge of groundwater in Ash Shati' area is scant and infrequent. Probably much of the water in the aquifer system dates from the Pleistocene. Discharge of water through wells and springs has increased, because of recent drilling, to about 83,000 cu m/day. Pressure head declined about 3 m from 1950 to 1962. About 43% of the discharge is wasted. The excess water causes waterlogging. Evaporation of the water deposits salts in soil in such quantity as to alter soil structure and stunt or preclude growth of crops. (Knapp-USGS)
W70-03306

MEASURING UNDERGROUND-EXPLOSION EFFECTS ON WATER LEVELS IN SURROUNDING AQUIFERS,
Geological Survey, Denver, Colo.
For primary bibliographic entry see Field 08H.
W70-03375

WATER LEVELS IN ARTESIAN AND NONARTESIAN AQUIFERS OF FLORIDA, 1965-66,
Geological Survey, Tallahassee, Fla.
Henry G. Healy.
Florida State Department of Natural Resources, Bureau of Geology, Information Circular No 61, 1970. 71 p, 47 fig, 1 tab, 1 append.

Descriptors: *Water levels, *Water wells, *Aquifers, *Water level fluctuations, *Florida, Data collections, Hydrologic data, Hydrographs, Surveys, Investigations, Artesian wells.
Identifiers: Florida aquifers.

Water level data from the principal aquifers of Florida, 1965-66 are summarized in tables, hydrographs, and maps. Although groundwater supplies have been adequate in most areas, water levels have declined appreciably in some. Because demand for groundwater continues to increase, shortages will occur and may become critical in some areas. In coastal areas, declining water levels may allow salt water to encroach and shortages could result from deterioration in quality as well as from the reduction of quantity of water available. The water-level data represent measurements taken from automatic water-stage recorder charts, pressure gages, and made by tape. Highest and lowest water levels of record prior to 1965 are given. (Knapp-USGS)
W70-03443

RECONNAISSANCE APPRAISAL OF THE WATER RESOURCES NEAR ESCALANTE, GARFIELD COUNTY, UTAH,
Utah Univ., Salt Lake City. Dept. of Geological and Geophysical Sciences.
Harry D. Goode.
Report available for sale from Utah Geological and Mineralogical Survey, Univ of Utah, Salt Lake City - Price $2.00. Water Resources Bulletin 11, Utah Geological and Mineralogical Survey, Oct 1969. 38 p, 5 fig, 12 plate, 8 tab, 22 ref.

Descriptors: *Water resources, *Groundwater, *Utah, Water wells, Aquifers, Sandstones, Water yield, Water quality, Arid lands, Irrigation water, Water resources development.
Identifiers: Escalante (Utah), Garfield County (Utah).

Surface waters, except for outflow of perhaps 4,000 to 5,000 acre-ft a year down Escalante Canyon and Alvey Wash, Utah are essentially fully appropriated. Dams in Escalante Canyon or Pine Creek or drains in the valley fill in Escalante Canyon and Alvey Wash could capture most of the outflow. Because the water so captured would not satisfy the amounts desired for irrigation, the Entrada (base about 600 ft deep) and/or Navajo Sandstones (top about 1000 ft deep) are suggested for groundwater development. Both formations are porous enough to be good aquifers and both are in favorable geologic positions for producing water. If the Navajo is saturated throughout its thickness of 1500 ft, tremendous quantities of water, estimated at 50,000 to 60,000 acre-ft per sq mi, are in storage and are probably under artesian pressure from the recharge area of the Navajo along the axis of the Escalante anticline. Development of either or both of these probable aquifers could yield the desired 15,000 acre-ft of water from perhaps twenty 20-inch wells. Chemical analyses of spring and surface waters suggest that good water is available from both springs and surface waters. (Knapp-USGS)
W70-03454

RECORDS OF WATER-LEVEL MEASUREMENTS IN OBSERVATION WELLS IN HARRIS COUNTY, TEXAS,
Geological Survey, Austin, Tex.
R. K. Gabrysch, W. L. Naftel, and Gene McAdoo.
Texas Water Development Board Report 103, Dec 1969. 252 p, 1 fig, 1 tab, 4 ref.

Descriptors: *Water levels, *Groundwater, *Observation wells, *Data collections, *Texas, Hydrologic data, Water level fluctuations, Aquifers.
Identifiers: *Harris County (Tex).

A compilation of water-level measurements for Harris County, Texas wells for 1929-1969 is presented. Water-level measurements in most observation wells are made annually, but some measurements are made monthly, quarterly, or semiannually. A continuous record is obtained at a few locations where water-stage recorders are installed. If numerous measurements in a well were made during a short period of time or if water-level data were obtained from a water-stage recorder, representative water levels were selected for publication. (Knapp-USGS)
W70-03459

OCCURRENCE AND QUALITY OF GROUNDWATER IN SHACKELFORD COUNTY, TEXAS,
Texas Water Development Board, Austin.
Richard D. Preston.
Texas Water Development Board Report 100, Oct 1969. 58 p, 14 fig, 8 tab, 61 ref.

Descriptors: *Water resources, *Groundwater, *Water quality, *Texas, Water pollution sources, Brines, Oil fields, Aquifers, Water wells, Water yield, Data collections, Hydrologic data.
Identifiers: Shackelford County (Tex).

Shackelford County is in the drainage basin of the Brazos River in north-central Texas. Permian rocks of the Wichita and Clear Fork Groups, dipping gently to the northwest, are found at the surface within the county. Alluvial deposits of Quaternary age are found along the major streams in the county. Small amounts of groundwater, used mostly for household needs and watering livestock, are produced from formations of Permian age and from Quaternary alluvial deposits. Methods of disposal of oil-field brines are the probable cause of some of the poorer water quality in Shackelford County. Disposal of brine is also responsible for extensive soil damage and vegetative kill in some areas of the county (Knapp-USGS)
W70-03460

GROUNDWATER RESOURCES OF THE ST. JAMES AREA, SOUTH-CENTRAL MINNESOTA,
Geological Survey, Washington, D.C.
L. H. Ropes.
Available from US Geological Survey, Wash, DC, 20240 -- Price $0.50. Geological Survey Hydrologic Investigations Atlas HA-334, 1 sheet, 1969. Text, 14 fig, 1 tab, 4 ref.

Descriptors: *Water resources, *Groundwater, *Minnesota, Aquifers, Water yield, Water quality, Water wells, Water supply, Hydrogeology, Hydrologic data, Water table, Water sources.
Identifiers: St. James (Minn).

A 1-sheet hydrological atlas shows the quality and iuantity of groundwater resources in the area of St. James, Minnesota on maps, charts, cross sections and text. The area is covered by a thick layer of glacial drift which is underlain by Cretaceous, Cambrian, and Precambrian rocks. St. James presently obtains its water supply from two aquifers. One is a Cretaceous sandstone 160 ft below the surface, in which two wells are completed. This aquifer yields abundant water but it is of poor quality and is expensive to treat. The second source, tapped by three municipal wells, is a surficial sand and gravel deposit less than 40 ft thick at the well field. This aquifer produces water of better quality, but its extent and capacity are not known. There are other wells in the area completed at depths ranging from 15 to 500 ft. The surficial sand and gravel aquifer is easily drilled and contains water of good quality. Pumping tests on wells 3780 and 5756 indicate coefficients of transmissibility (T) of 3,000 and 10,000 gpd/ft respectively. The storage coefficient (S) is estimated to be in the range of 0.1 to 0.2. An abundant supply of moderately to highly mineralized water is available from the Cretaceous sandstone aquifer at depths generally less than 200 feet. (Knapp-USGS)
W70-03477

ANALYSIS OF GROUNDWATER FLOW AND RAINFALL LOSS,
Kyoto Univ. (Japan). Disasters Prevention Research Inst.
For primary bibliographic entry see Field 02A.
W70-03489

2G. Water in Soils

MEASUREMENT OF EARTH DISPLACEMENTS INDUCED BY FLUID FLOW,
Stanford Univ., Calif.
Stanley N. Davis, Frank L. Peterson, and Allan D. Halderman.
Report available from Clearinghouse as PB-182 483, $3.00 in paper copy, $0.65 in microfiche. Final Report of Stanford University to National Science Foundation on Project: Micromovements of the Land Surface Produced by Subsurface Flow of Fluids, 1969. 32 p, 4 fig, 14 ref. NSF Project GP-985.

Descriptors: *Groundwater movement, *Strain, *Strain measurement, *Extensometers, Subsidence, Withdrawal, Instrumentation, Darcys law, Discharge (Water), Water level fluctuations, Aquifers, Elasticity (Mechanical).
Identifiers: Earth strain-groundwater relations, Aquifer strain.

Fluid flow to wells produces strain that has been measured as horizontal, vertical, and rotational displacements of reference points fixed on the ground surface. Most linear displacements measured were between 1 and 100 microns and angular displacements were a few microradians. Of the various devices used, a horizontal extensometer proved to

be the most accurate and versatile. Deflections of the land surface resembled quite closely the theoretical vertical deflections caused by a point load on a plate of infinite extent resting on an elastic foundation. Short-term reactions of aquifers are largely elastic except in geologically young materials. Significant horizontal strain was measured in all materials tested. This suggests that accepted equations for fluid discharge from wells should be modified for special conditions near the wells.
W70-03455

HYDROLOGIC CAPACITIES OF SOILS IN WATERSHED ENGINEERING,
Agricultural Research Service, Beltsville, Md. Hydrograph Lab.
H. N. Holtan, C. B. England, and W. H. Allen, Jr.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 29, p 218-226, 1967. 9 p, 5 fig, 3 tab, 10 ref.

Descriptors: *Infiltration, *Surface-groundwater relationships, *Model studies, *Mathematical models, Vegetation effects, Soil water movement, Percolation, Overland flow, Runoff, ·Hydrologic budget, Water storage, Evapotranspiration.
Identifiers: Intermittent rainfall-infiltration model.

A mathematical model is proposed for computing infiltration during intermittent rainfall based upon readily available information on soils and vegetation. The model is adapted to long-term soil moisture accounting and to the computations of areal and temporal distributions of rainfall excess during a storm in sequences compatible with the hydraulics of overland flow. (Knapp-USGS)
W70-03493

THE RECOVERY OF THE INFILTRATION CAPACITY AFTER DRAINAGE,
Cornell Univ. Ithaca, N.Y.
Hassan A. Ibrahim, and Wilfried Brutsaert.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 30, p 227-234, 1967. 8 p, 6 fig, 11 ref.

Descriptors: *Unsaturated flow, *Porous media, *Drainage, *Mathematical models, Groundwater movement, Soil water movement, Infiltration, Hydrograph analysis, Runoff forecasting, Equations.
Identifiers: Flow equations.

Some numerical solutions of the differential equation describing flow in partly saturated porous media are presented. A high speed digital computer was used to obtain these solutions for different initial and boundary conditions representing alternating infiltration and drainage cycles. The hysteresis in the moisture-suction relationship was taken into account and its effect was studied. To increase the applicability of the solutions to a wider variety of field conditions, they are given in dimensionless form. The implications of the obtained results in connection with hydrograph analysis are discussed. (Knapp-USGS)
W70-03495

2H. Lakes

GREAT LAKES NEARSHORE MODELLING FROM CURRENT METER DATA,
Ontario Water Resources Commission, Toronto.
For primary bibliographic entry see Field 05B.
W70-03253

A RECONNAISSANCE OF THE QUALITY OF WATER IN LAKE DICIE AND WEST CROOKED LAKE NEAR EUSTIS, FLORIDA,
Geological Survey, Tallahassee, Fla.
For primary bibliographic entry see Field 05C.
W70-03260

GREAT SALT LAKE, UTAH: CHEMICAL AND PHYSICAL VARIATIONS OF THE BRINE, 1963-1966,
Geological Survey, Salt Lake City, Utah.
D. C. Hahl, and A. H. Handy.
Report available for sale from Utah Geological and Mineralogical Survey, Salt Lake City, Utah for $2.00. Utah Geological and Mineralogical Survey Water Resources Bulletin 12, 1969. 33 p, 16 fig, 7 tab, 26 ref, append.

Descriptors: *Water chemistry, *Brines, *Great Salt Lake, *Utah, Saline Lakes, Water quality.
Identifiers: Brine properties.

Studies to define the variations in chemical and physical characteristics of Great Salt Lake brine began in 1963. Four types of brine coexist in the lake. Completion of a railroad causeway by the Southern Pacific Co. in 1957 divided the lake into 2 parts and altered the movement of brine. The northwestern part of the lake was essentially cut off from direct fresh-water inflow by the causeway, and as a result it was saturated and well mixed from 1963 to 1966. The southern two-thirds of the lake receives over 90% of the surface inflow and since 1957 has rarely reached saturation. The southern part of the lake is not well mixed, and 3 types of brine have been identified. These brines are located (1) in a zone from the surface to a depth of about 16 ft, (2) in the zone below 16 ft south of the causeway, and (3) in the zone below 16 ft in the south end of the lake. Brine in the shallow southern zone is usually the most dilute of any brine in the lake. The concentrations of dissolved solids of the deep brines vary seasonally. Brine in the deep zone near the south side of the causeway is maintained by a density current that flows from the northern part of the lake through the causeway. Brine in the deep zone at the south end of the lake has a high concentration of sodium and low concentration of sulfate. Brine north of the causeway is reddish-brown and visibility in it is about 2 ft, whereas brine south of the causeway is green and features 15 ft deep can often be clearly seen. (Knapp-USGS)
W70-03279

FACTORS INFLUENCING PHOTOSYNTHESIS AND EXCRETION OF DISSOLVED ORGANIC MATTER BY AQUATIC MACROPHYTES IN HARD-WATER LAKES,
Michigan State Univ., Hickory Corners. W. K. Kellogg Biological Station.
Robert G. Wetzel.
Verhandlungen der Internationalen Vereinigung fur Theoretische und Angewandte Limnologie, Vol 17, p 72-85, Nov 1969. 8 fig, 10 tab, 22 ref.

Descriptors: *Photosynthesis, *Organic matter, *Lakes, *Aquatic plants, *Hardness (Water), Marl, Productivity, Great Lakes, Inorganic compounds, Tracers, Biomass, Calcium, Temperature, Light intensity, Magnesium, Sodium, Potassium, Ecology, Diatoms, Phosphates, Hydrogen ion concentration, Carbon radioisotopes, Metabolism, Oxygen, Hypolimnion, Algae, Bacteria.
Identifiers: *Macrophytes, *Excretion, Dissolved organic compounds, Najas flexilis.

Experimental results with Najas and concomitant investigations on phytoplanktonic organic-inorganic nutrient relationships and direct organic-inorganic chemical interactions show some major cyclic factors regulating photosynthesis in calcareous lakes. Marl lakes exhibit low primary production rates and relatively high hypolimnetic oxygen concentrations which usually remain, although reduced, through or to terminal summer stratification, compounded by years of partial, usually vernal, meromixis. Sedimentary nutrient release is variable and upon recirculation into the alkaline trophogenic zone, largely lost as relatively insoluble carbonates hydroxides, and phosphates, some loss is permanent in dense, calcareous sediments. High levels of calcium, bicarbonate-ion and carbonate-ion combined with high magnesium, low levels of sodium and potassium, and high pH, form a buffered trophogenic littoral zone, relatively untenable for assimilation of certain nutrients. Calcium carbonate in colloidal and particulate form adsorbs certain dissolved organic compounds and this complex serves as a 'sump' reducing function of dissolved organics in direct metabolic utilization and complexing of physiologically unavailable metallic nutrients. Availability of carbon and differential bicarbonate utilization appear major limitations to photosynthetic production. These factors, among others, and their interactions function in a dynamic cyclic causal system to self-perpetuate suppressed potential productivity in marl lakes. (Jones-Wisconsin)
W70-03307

A STUDY OF THE OPEN WATER DISTRIBUTION AND ABUNDANCE OF NET PLANKTON AS AN INDEX OF EUTROPHICATION IN LAKE SUPERIOR,
Minnesota Univ., Minneapolis. School of Public Health.
T. A. Olson.
Technical Completion Report, June 1969. 2 p. OWRR Project No A-011-MINN.

Descriptors: *Lakes, *Great Lakes, *Lake Superior, *Eutrophication, *Zooplankton, *Primary productivity, Lake Huron, Lake Michigan, Lake Erie, Water pollution effects, Bioindicators, Carbon radioisotopes, Phytoplankton, Water pollution sources, Environmental effects, Secondary productivity, Water quality, Oligotrophy, Analytical techniques.
Identifiers: *Net plankton, Hardy Continuous Plankton Recorder, Radiocarbon uptake technique, Plankton abundance, Plankton distribution, Seasonal variations, Daily variations, Water masses, Water pollution assessment.

Based upon criteria of net plankton abundance, determined with the Hardy Continuous Plankton Recorder (CPR), and primary plankton productivity (PPP), determined from measurements of carbon-14 uptake, the status of four Great Lakes sampled, in increasing order of eutrophication, is: Superior, Huron, Michigan, Erie. Lake Erie is more than fourfold productive than any other lake sampled. Eutrophication increases progressively from north to south. Mean seasonal productivity generally increased with ascending temperature of surface waters. Sharply delineated regions of high zooplanktonic density was observed, as expected. Species composition and abundance of zooplankton differ among water masses within lakes, showing seasonal and daily variations. Zooplankters are more abundant locally in chemically polluted areas within lakes. Lowest PPP was observed in central Lake Superior. Lower lakes are most productive, and especially marked increases in PPP occur in regions where massed population and industry have enriched the lakes. Radiocarbon uptake and CPR are effective tools for study of trophic status of waters of Great Lakes Basin, and CPR can provide assessment of pollution and eutrophication on a scale hitherto unavailable for the Great Lakes. (Eichhorn-Wisconsin)
W70-03311

COMPONENTS OF THE BOTTOM FAUNA OF THE ST LAWRENCE, GREAT LAKES,
Toronto Univ (Ontario). Dept. of Zoology; and Fisheries Research Board of Canada, Winnipeg (Manitoba).
R. O. Brinkhurst, A. L. Hamilton, and H. B. Herrington.
Great Lakes Institute, Univ of Toronto, No PR 33, Mar 1968. 50 p, 7 tab, 23 ref, appendix with 11 fig.

Descriptors: *Benthic fauna, *Great Lakes, *St Lawrence River, Oligochaetes, Sampling, Seasonal, Depth, Lake Erie, Lake Ontario, Tubificids, Distribution, Water pollution, Eutrophication, Oligotrophy, Littoral, Limnology, Bathymetry, Temperature, Ecology, Trophic, Lake Huron, Oxygen.
Identifiers: Sphaeriidae, Chironomidae, Georgian Bay (Ontario), Mesotrophic, Lake Nipigon (Ontario), Lake Athabaska (Ontario), Great Slave

Lake (Ontario), Cree Lake (Ontario), Patricia District Lakes, Straits of Mackinac, Species composition, Detroit River, Maumee River, Taxonomy, Core analyses, Chemical conditions, Taxonomic keys.

Bottom fauna were sampled during synoptic cruises through Georgian Bay, Lake Ontario, and Lake Erie and distributions of their major components determined. Oligochaeta, Sphaeriidae, and Chironomidae were separated. Identity of species and their distribution is discussed. Reference is made to other Great Lakes studies on benthos. Samples representing all seasons were included where possible. Results are presented in taxonomic groups and distribution maps. Maps of depth profiles, indicating degree of oxygen depletion in Lake Erie in summer, and bathymetrical maps are included. 31 species of Tubificidae from the Great Lakes and some in Canadian lakes are recorded. In grossly polluted situations, the number of Oligochaetes is very high. Species of the Sphaeriidae identified in the Great Lakes Institute collection are listed. The taxa of Chironomidae, reasonably complete in assessment of the profundal and sublittoral fauna, from these three lakes are listed. To facilitate comparison between these lakes a measure of the 'trophic conditions' of each area was calculated according to ability to withstand eutrophic conditions, providing numerical values which aid in the comparisons of various bodies of water. Key to Tubificidae is given. (Jones-Wisconsin)
W70-03315

CALCIUM IN SOLUTION IN THE LAKE WATERS OF JAPAN,
Tokyo Univ. (Japan). Geographical Inst.
Shinkichi Yoshimura.
Japanese Journal of Geology and Geography, Vol 10, No 1-2, p 33-60, 1932. 2 fig, 7 tab, 52 ref.

Descriptors: *Lakes, *Japan, *Calcium, *Carbonates, Carbon dioxide, pH, Stratification.
Identifiers: *Calcium stratification, Holopedium gebberum, Soft-water lakes, Hard-water lakes, Japanese lakes.

The determination of calcium, carbonates, carbon dioxide, and pH of several Japanese lakes disclosed their very low calcium content. The maximum observed concentration of calcium was 25 parts per million; in most lakes the content is between 5 and 10 parts/million. No deposits of marl or calcium carbonate incrustations have yet been observed in Japanese inland lakes. In comparison with inhabitants of hard waters, the shells of molusca are very thin. Slight stratification of calcium during the stagnation period is not due to precipitation as calcium carbonate, but some other, thus far undisclosed, causes. The one inhabitant well tolerating the low calcium content is Holopedium gebberum. (Wilde-Wisconsin)
W70-03316

EFFECTS OF FERTILIZER ON FOOD CHAIN ORGANISMS AND FISH PRODUCTION IN NORRIS RESERVOIR, TENNESSEE,
Tennessee Valley Authority, Norris. Fish and Wildlife Branch.
C. E. Wood, and T. L. Sheddan.
Tennessee Valley Authority, Fish and Wildlife Branch publication, 1968. 19 p, 5 fig, 11 tab, 8 ref.

Descriptors: *Fertilizers, *Fish food organisms, Aquatic insects, Nitrogen, Phosphorus, Benthic fauna, Forage fish, Tennessee, Zooplankton, Food chains.
Identifiers: *Fish production, Game fish, Norris Reservoir (Tennessee), Clinch River (Tennessee).

Six coves of Norris Reservoir were treated with fertilizer (monoammonium phosphate and ammonium sulfate) in order to (1) ascertain effects of fertilizer on production of game fish and fish food organisms and (2) determine the practibility of fertilization for improvement of game fish production in specific areas. Coves were fertilized at rates of 100 and 50 micrograms/liter nitrogen and 50 and 25 micrograms/liter phosphorus; 2 coves served as controls. Three zooplankton blooms were noted following fertilization, one coinciding with increasing temperature and one coinciding with increased rainfall and surface runoff. Rotifers were most numerous in all coves, copepods and cladocerans were of secondary importance among the zooplankton. Tendiped larvae dominated benthic fauna; tubificids and midge larvae (Ceratopogonidae) contributed important numbers. Benthic fauna were significantly more abundant in coves exposed to lower fertilizer levels. Forage fish dominated samples; no numerical increase of game fish was noted. Amount of fertilizer lost through sinking and flushing was not determined. Graphical and tabular data include hydrography, chemical analyses, and biological analyses of samples from all coves. (Voigtlander-Wisconsin)
W70-03317

THE DISTRIBUTION OF AMMONIA, NITRATES, NITRITES, AND PHOSPHATES IN LAKE CONSTANCE (OBERSEE) IN APRIL 1964 (In German),
Gustav Wagner.
English summary. Archiv fur Hydrobiologie, Vol 61, No 3, p 395-401, June 1965. 1 fig, 3 tab, 10 ref.

Descriptors: *Nitrogen, *Nitrites, *Nitrate, *Phosphorus, Stratification, Thermal stratification, Ammonia, Depth, Water quality, Nitrogen.
Identifiers: Lake Constance, Obersee (Bodensee).

Analyses of water in the early April 1964 indicated incomplete thermal circulation during the preceeding winter. The effect of water of different quality produced irregularities in stratification. The content of ingredients (phosphate, ammonium, nitrite, and nitrate) in the beginning of spring stagnation showed that during the past five years the annual increase of nitrate nitrogen was at a rate of 100 to 150 milligrams/cubic meter, and that of phosphorus at a rate of 2 milligrams/cubic meter. (Wilde-Wisconsin)
W70-03318

STUDIES ON THE SEDIMENTATION IN LAKE BIWA FROM THE VIEWPOINT OF LAKE METABOLISM,
Kyoto Univ. (Japan). Otsu Hydrobiological Station.
Yoshimasa Toyoda, Shoji Horie, and Yatsuka Saijo.
German summary. Mitteilungen Internationale Vereinigung fur Theoretische und Angewandte Limnologie, p 243-255, Mar 1968. 8 fig, 2 tab, 10 ref.

Descriptors: *Lakes, *Metabolism, *Sedimentation, *Seasonal, Stratification, Nitrogen, Phosphorus, Seston, Bottom sediments, Inflow, Degradation (Decomposition).
Identifiers: *Lake Biwa, Euphotic layer, Lake metabolism, Seasonal effects, Chlorophyll a, Sediment age.

The annual rate of deposition of suspended matter near the bottom of Biwa, the largest lake in Japan (674 square kilometers), was estimated as 208 grams/square meter on dry weight basis. The maximum daily deposition of 3 to 6 grams/square meter was in April and May; it decreased in winter to 0.1 gram/square meter. The process was in fair agreement with water outflow, but no correlation was discovered between deposition and the amount of seston. A considerable fraction of organic nitrogen reaches the deposit, whereas most of phosphorus is converted into silicate form in the trophogenic layer. Annual contribution of organic nitrogen to the deposit was only 1/8 to 1/20 of its supply provided by primary production and inflow of seston. Age of bottom sediment was determined on the basis of annual deposition and total content of silicates. The yearly decomposition of nitrogen compounds in the bottom sediment was estimated as 680 milligrams/square meter, that of phosphorus compounds, as 130 milligrams/square meter. (Wilde-Wisconsin)
W70-03319

LIMNOLOGICAL STUDIES OF LAKE NORRVIKEN, A EUTROPHICATED SWEDISH LAKE. I. WATER CHEMISTRY AND NUTRIENT BUDGET,
Uppsala Univ. (Sweden). Inst. of Limnology.
Ingemar Ahlgren.
Schweizerische Zeitschrift fur Hydrologie, Vol 27, No 1, p 53-90, 1967. 22 fig, 7 tab, 46 ref.

Descriptors: *Eutrophication, Inflow, Sampling, Water analysis, Temperature, Oxygen, Hydrogen sulfide, Iron, Sedimentation, Water pollution effects, Water pollution, Water pollution sources, Nitrogen, Phosphorus, Nutrients.
Identifiers: *Lake Norrviken (Sweden), Ruttner water sampler, Oxygen concentration, Madison (Wis) lakes, Transparency, Nutrient budget.

Discharge of yeast factory refuse and sewage from communities involving 1,300 people have imparted to 266 hectare Lake Norrviken in central Sweden, an extreme degree of eutrophication. Nitrogen and phosphorus are now accumulating in amounts of 44,000 and 5,280 kilograms/year, respectively. The present nitrogen concentration is as high as 3.4 parts per million (ppm) and that of phosphorus 0.26 ppm, inducing luxuriant development of macrovegetation and planktonic algae. The two major consequences include nuisance bloom of blue-green algae and a critical deficiency of oxygen; under ice cover the entire mass of water becomes oxygen-free. Water waste from the yeast factory delivers more than 80% of nitrogen and 70% of phosphorus. Phosphorus accumulates in the sediment; a large fraction of nitrogen compounds presumably undergoes reduction to free nitrogen. (Wilde-Wisconsin)
W70-03322

FERTILIZATION OF LAKES IN ALGONQUIN PARK, ONTARIO,
Toronto Univ. (Ontario); and Department of Lands and Forests (Ontario).
R. R. Langford.
Transactions of the American Fisheries Society, Vol 78, p 133-144, 1948. 5 fig, 4 tab, 7 ref.

Descriptors: *Fertilization, *Lakes, Productivity, Phytoplankton, Nutrients, Zooplankton, Diatoms, Protozoa, Rotifers, Copepods, Oceans, Fresh water, Biota, Environment, Benthos, Forage fish, Biomass, Nitrogen, Phosphorus, Potassium, Acreage, Depth, Epilimnion, Nannoplankton.
Identifiers: *Algonquin Park (Ontario), Flagellates, Chemical fertilizer, Game fish, Brewer Lake (Ont), Cache Lake (Ont), Dissolved chemicals, Fragillaria Tabellaria, Melosira, Dinobryon, Asterionella, Synura, Cyclops, Keratella, Notholca, Polyarthra, Diaptomus, Kearney Lake (Ont), Costello Lake (Ont), McCauley Lake (Ont).

Since many lakes in the Canadian Shield area of Ontario are poor in dissolved minerals and low in fish productivity, an investigation was made of the possibilities of increasing yield by fertilization. For a complete analysis of fertilization results, changes in the complex biota and physical environment were followed. Fertilization was begun in Algonquin Park in 1946 as part of the investigation of factors controlling lake productivity. Four lakes had been fertilized and one other used as a control. Detailed analyses were conducted to assess changes in dissolved chemicals, the plankton, bottom organisms, forage fish, and game fish, in order to determine the fate of the augmented inorganic nutrients in the biomass. The response of phytoplankton and zooplankton populations to increased nutrients is indicated. Marked increase in net phytoplankton occurred in each lake from three weeks to a month after first application. Diatoms and flagellate protozoans showed the greatest increment. Rise in zooplankton organisms

was relatively lesser than of phytoplankton although the rotifer populations did increase in all lakes. (Jones-Wisconsin)
W70-03323

THE INFLUENCE OF SOME ENVIRONMENTAL FACTORS ON STANDING CROP AND HARVEST OF FISHES IN US RESERVOIRS,
Bureau of Sport Fisheries and Wildlife, Fayetteville, Ark.
Robert M. Jenkins.
Reservoir Fishery Resources Symposium, Athens, Georgia, Apr 5-7, 1967, p 298-321, Nov 1968. 4 fig, 9 tab, 18 ref.

Descriptors: *Environmental effects, *Reservoir fisheries, Commercial fish, Dissolved solids, Multiple-purpose reservoirs, Regression analysis, Sport fish, Fish, Standing crop, Reservoirs.
Identifiers: Clupeids, Multiple regression analysis, Storage ratios.

Multiple regression analyses were performed to ascertain the effects of nine environmental factors on sport and commercial fish standing crops and harvests in 127 reservoirs in 33 states. Factors exerting greatest positive influence included total dissolved solids on standing crop and sport fish yield; age of reservoir on clupeid standing crop and commercial harvest. Strong negative influences include age of reservoir on sport harvest; area on sport harvest; mean depth and shoreline development on commercial harvest. Multiple regression models of greatest predictive utility include standing crop on dissolved solids divided by mean depth; standing crop on dissolved solids, shore development and storage ratio; commercial harvest on growing season, mean depth, storage ratio, age, and water level fluctuation. Tabular data include results of single-factor and multiple regressions and a complete tabulation of all data utilized on the reservoirs studied. (Voigtlander-Wisconsin)
W70-03324

SOME EFFECTS OF LAKE RENEWAL ON PHYTOPLANKTON PRODUCTIVITY AND SPECIES COMPOSITION,
British Columbia Univ., Vancouver. Inst. of Fisheries.
Mike Dickman.
Limnology and Oceanography, Vol 14, No 5, p 660-666, Sept 1969. 6 fig, 11 ref.

Descriptors: *Lakes, *Phytoplankton, *Primary productivity, Light intensity, Biomass, Water pollution effects, Eutrophication, Oligotrophy, Nannoplankton, Limiting factors, Rainfall, Carbon radioisotopes, Environmental factors, Chlorophyta, Temperature, Diatoms, Periphyton, Grazing, Correlation analysis, Nutrients.
Identifiers: *Lake renewal, *Species composition, Marion Lake (B C), British Columbia, Canada, Flushing rates, Ratio (Production/Biomass), Instantaneous productivity rates, Radiocarbon uptake technique, Denmark, North Alouette River (B C), Pyrheliometry, Algal growth, Oocystis, Elakatothrix, Desmids, Flagellates, Resource factors, Cropping factors, Nutrient limited growth.

A continuum may exist between waters defined as streams or lakes. In small lakes with high runoff, factors limiting phytoplankton production, termed 'resource factors' may be secondarily important if considerable planktonic biomass is removed by flushing. With light intensities corrected to a standard level, primary production in Marion Lake, British Columbia, varies inversely with rates at which water enters. Increased flushing reduces phytoplanktonic biomass, thereby lowering lake's total primary productivity, with seasonal variations in rainfall greatly influencing annual productivity of phytoplankton. Lake water artificially enclosed by plywood containers (3.05 meters square) within small areas of the lake, produced blooms principally composed of larger green algae, while phytoplanktonic biomass in surrounding lake water remained low. In Marion Lake, nannoplankton apparently have a selective advantage as compared with larger, more slowly reproducing species. The ratio, production/biomass (P/B), may be useful in establishing whether resource or cropping factors have greater influence on instantaneous rates of productivity in lakes. Although a lake may apparently be highly oligotrophic, tests of possible limiting nutrients or other resources may have little value if both species composition and P/B clearly indicate that cropping factors limit primary productivity. (Eichhorn-Wisconsin)
W70-03328

LIMNOLOGICAL OBSERVATIONS ON WESTERN LAKE SUPERIOR,
Minnesota Univ., Minneapolis. School of Public Health; and Minnesota Univ., Duluth. Dept. of Biology.
Theodore A. Olson, and Theron O. Odlaug.
Great Lakes Research Division, The University of Michigan, Publication No 15, p 109-118, 1966. 2 fig, 5 tab, 5 ref.

Descriptors: *Limnology, *Lake Superior, Productivity, Crustaceans, Chlorophyll, Carbon, Depth, Seasonal, Light penetration, Biomass, Water measurement, Carbon radioisotopes, Energy, Trophic level, Water quality, Ecosystems, Zooplankton, Phytoplankton, Tracers, Sampling, Volume, Daphnia, Weight, Standing crop, Grazing, Termocline, Temperature, Primary productivity.
Identifiers: Larsmont-Knife River (Minn), Limnocalanus macrurus, Bosmina coregoni, Daphnia pulex, Daphna longispina, Polyphemus pediculus, Leptodora kindtii, Dinobryon sertularia, Coccochloris elebens, Asterionella formosa, Crucigenia tetrapedia, Cyclotella Kutzingiana, Synedra acus.

This summer period study, concerned with 1964 Lake Superior productivity estimates, is based on total plankton counts, abundance of plankton crustacea, quantity of chlorophyll and carbon fixation values found in water samples from the Larsmont-Knife River area. Counts of centrifuged plankton ranged from 21 to 55 organisms/milliliter. At the 5-meter level, minimum was 21 organisms and maximum 48; at 10 meters, range was 29 to 45. Crustacean counts varied with advancing season and depth. Counts obtained by Clarke-Bumpus (C-B) hauls varied from 39 (July 16) to 9,177 organisms per C-B scale unit (August 13). At 10-meter level, daylight counts ranged from 437 (July 16) to 9,177 (August 13) per C-B unit. At 30 meters, well below the 1% light transmission level, daylight counts were 51 and nightly counts 30 organisms/scale unit. One observation (August 6) showed the number at 30-meter depth can reach the level of one organism/7 liters. Chlorophyll varied from 0.5 milligrams (July 28) to 3.2 (August 4) per cubic meter. Concentration also varied with depth and water mass. Carbon fixation values (C-14 technique) varied from 0.13 to 0.73 milligrams carbon fixed/cubic meter per hour. (Jones-Wisconsin)
W70-03329

CHIRONOMIDA AND THE STUDY OF LAKE TYPES,
Franz Lenz.
Die Naturwissenschaften, Vol 13, p 5-10, 1925. 12 ref.

Descriptors: *Lakes, Limnology, Eutrophication, Oligotrophy, Nutrients, Basins, Dystrophy, Oxygen, Depth, Sedimentation, Plankton, Dissolved solids, Metabolism, Respiration, Nitrogen, Phosphorus, Calcium, Humus, Biological communities, Ecology, Temperature, Ponds, Streams.
Identifiers: *Chironomida, *Lake types, Tanytarsus, Mesotrophy, Polytrophy, Fauna, Lauterbornia coracina, Prodiamesa bathyphila, Monodiamesa bathyphila, Mysis relicta, Norway, Finland, North Germany, Lunzer Untersee, Vierwaldstatter See, Didiamesa miriforceps, Sergentia, Polypedilum, Stictochironomus, Einfelder See (Holstein), Einfeldia insolita Kieffer, Chironomus plumosus, Chironomus bathophilus, Lenzia, Pentapedilum, Sweden.

An outline of the role played by Chironomida in lake characteristics, systematics, and solutions to problems is given. Most eutrophic lakes belong to the Chironomus lake type; all oligotrophic lakes are Tanytarsus lakes. Oxygen content of deep water plays the major role in regulating colonization. All factors contained in the milieu spectrum can exert an influence on members of the biocoenosis whether they directly promote, inhibit, or disturb life functions or indirectly change environment. That Chironomidae do not uniformly colonize the depths of Tanytarsus lakes is affirmed. Their components can be associated with different biocoenoses and can occur in different intensities. Lakes' character can be altered decisively in any direction by change in primary factor complex, or milieu spectrum. Variation in composition of the Chironomida fauna in Tanytarsus lakes may be based on different causes. Definite forms have developed or colonized with adaptation to specific characteristics. Factors which determine the environment influence the elimination of certain forms, then other types, having a greater adaptation range, can assume their place. (Jones-Wisconsin)
W70-03332

ECOLOGY OF CHIRONOMIDAE, CHAOBORIDAE, AND OTHER BENTHOS IN FOURTEEN WISCONSIN LAKES,
Wisconsin Univ., Madison. Dept. of Entomology.
William L. Hilsenhoff, and Richard P. Narf.
Annals of the Entomological Society of America, Vol 61, No 5, p 1173-1181, Sept 1968. 4 fig, 4 tab, 5 ref.

Descriptors: *Ecology, *Benthos, *Wisconsin, *Lakes, Copepods, Hydrogen ion concentration, Organic matter, Mud, Eutrophication, Thermocline, Profundal zone, depth, Sampling, Temperature, Oxygen, Oxidation-reduction potential, Light intensity, Suspended load, Nitrites, Ammonia, Phosphorus, Iron, Crustaceans.
Identifiers: *Chironomidae, *Chaoboridae, Chironomus plumosus, Procladius, Chaoborus punctipennis, Chaoborus albatus, Palpomyia, Ostracoda, Chironomus 'A', Chironomus staegeri, Chironomus 'C', Chironomus attentuatus, Clear water, North America, Taxonomic key, Chironomus tentans, Chironomus 'D', Chironomus atroviridis, Chironomus paganus, Chironomus 'B'.

Benthos ecology in the profundal zones of 14 Wisconsin lakes was studied for three years. Chironomid larva were reared to the imago for identification, and a key to species of Chironomus larvae constructed. Population of 10 species of Chironomus, Procladius, three species of Chaoborus, Palpomyia, Ostracode, and Copepoda were determined from monthly samples and correlated with 14 physical and chemical characteristics, to determine possible relationships. Chironomus plumosus (L), Procladius larvae, and Ostracoda occurred in the same lakes, and this incidence was positively correlated with a high pH of the mud and negatively related with the amount of organic matter in mud. Presence of C attenuatus Walker and Palpomyia larvae was correlated with clear water. Chironomus 'A', C staegeri Lundbeck, and Chironomus 'C' were most common in the same lake. Chaoborus punctipennis (Say) larvae were frequent in lakes forming a summer thermocline, and Copepoda were abundant in the most eutrophic lakes. Details on specie occurrence are given, with notes on rarer insects in the profundal zones. The third most plentiful insect family in the profundal mud was Ceratopogonidae. (Jones-Wisconsin)
W70-03333

LAKE MICHIGAN BEACH SURVEY 1968.
Illinois State Sanitary Water Board, Springfield.
For primary bibliographic entry see Field 05C.
W70-03339

BIOLOGICAL N2 FIXATION IN LAKES,
Wisconsin Univ., Madison. Water Resources Center.
For primary bibliographic entry see Field 05C.
W70-03429

SUBAERIAL CEMENTATION AND SUBSEQUENT DOLOMITIZATION OF LACUSTRINE CARBONATE MUDS AND SANDS FROM PALEO-TUZ GOLU ('SALT LAKE'), TURKEY,
Heidelberg Univ., (West Germany). Sediment Research Lab.
For primary bibliographic entry see Field 02J.
W70-03446

LABORATORY COMPARISONS OF FRESHWATER AND SALT-WATER WHITECAPS,
Michigan Univ., Ann Arbor. Dept. of Meteorology and Oceanography; and Northern Michigan Univ., Marquette.
For primary bibliographic entry see Field 01B.
W70-03451

NEPHELOID LAYERS AND BOTTOM CURRENTS IN THE ARCTIC OCEAN,
Lamont-Doherty Geological Observatory, Palisades, N.Y.
For primary bibliographic entry see Field 02L.
W70-03463

A GRAIN SIZE ANALYSIS OF LONGSHORE-BARS AND TROUGHS, LAKE SUPERIOR, ONTARIO,
Lakehead Univ., Port Arthur (Ontario).
John S. Mothersill.
Journal of Sedimentary Petrology, Vol 39, No 4, p 1317-1324, Dec 1969. 8 p, 9 fig, 11 ref.

Descriptors: *Lakes, *Sediments, *Beaches, *Lake Superior, Sampling, Mapping, Mathematical studies, Statistical methods, Waves (Water), Petrology, Laboratory tests, Shores, Geology, Glaciation, Clays.
Identifiers: Lake beach sedimentation.

Grain size analyses of 186 samples from the axes of longshore-bars and troughs along the lake shelf at Batchawana Bay and Pancake Bay, Lake Superior, Ontario, show the longshore-bar sands to be better sorted and finer grained than the adjacent shoreward longshore-trough sands. In addition the longshore-bar sands are unimodal and tend to be positively 'skewed' whereas the longshore-trough sands may be either unimodal or bimodal and show a tendency towards negative skewness. This would suggest that the longshore-troughs were formed by the action of breaking waves that preferentially set the finer grained particles into motion. These finer grained particles were then moved lakeward by the undertow to form the longshore-bar areas. (Gabriel-USGS)
W70-03472

THE MAGNETIC SPHERULES IN SEDIMENTS OF LAKE MENDOTA, WISCONSIN,
Toronto Univ. (Ontario). Dept. of Geology; and Wisconsin Univ., Madison. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 05B.
W70-03504

PRELIMINARY STUDIES OF ZOOPLANKTON DISTRIBUTION WITH THE CONTINUOUS PLANKTON RECORDER,
Minnesota Univ., Minneapolis. Water Resources Research Center.
Wayland R. Swain, Theodore A. Olson, and Theron O. Odlaug
Available from the Clearinghouse as PB-189 294, $3.00 in paper copy, $0.65 in microfiche. Water Resources Research Center, Minnesota University, Minneapolis, WRRC Bulletin 7, Nov 1968. 21 p, 14 fig, 11 ref. OWRR Project A-011-MINN.

Descriptors: *Zooplankton, *sampling, *Lakes, *Biogeography, Great Lakes, Lake Superior, Lake Michigan, Minnesota, Illinois, Indiana, Species composition, Data acquisition, Limnology, Copepods, Cladocera, Phytoplankton, Diatoms.
Identifiers: *Hardy Continuous Plankton Recorder, Scottish Marine Biological Ass, Duluth (Minn), Chicago (Ill), Two Harbors (Minn), Gary (Ind), Patchiness, Plankton abundance, S S Cason J Callaway, Diaptomids, Mysis oculata relicta, Limnocalanus macurus, Diaptomus, Senecella, Daphnia pulex, Daphnia longispina, Bosmina corrigoni, Bosmina longirostris, Tabellaria fenestrata, Asterionella formosa.

The Hardy Continuous Plankton Recorder concentrates net plankton on a continuously unrolling belt of silk bolting cloth, which interceps a stream of water diverted through the sampler. Originally devised for use in the North Sea, the device has potential application in large fresh bodies of water. The sampler, towed by a commercial ore carrier, was tested over regular shipping routes in Lakes Superior and Michigan, sampling a transect 1/2-inch square and 300-500 miles long. Procedures are described for enumeration of plankton accumulated on the silk belts. Variations in abundance and species composition were noted between different areas of the lakes, such regional differences contributing to typical 'patchiness' of zooplankton distribution. Ratio of observed Copepoda to Cladocera is about 5:1. Limnocalanus macurus was the predominant copepod, while species of Diaptomus also contribute significantly. Marked daily variations in both abundance and faunal composition existed at depths of 10 meters, with maximum density occurring during hours of darkness. Large localized areas with abundant phytoplankton--largely the diatom Tabellaria fenestrata, but including Asterionella formosa in smaller numbers--were also encountered. (Eichhorn-Wisconsin)
W70-03506

I. PRODUCTIVITY: PRIMARY PRODUCTIVITY STUDIES IN LAKE TAHOE, CALIFORNIA,
California Univ., Davis. Dept. of Zoology.
For primary bibliographic entry see Field 05C.
W70-03508

PRESIDENT'S LECTURE: LIMNOLOGY, SOCIAL WELFARE, AND LAKE KINNERET,
Uppsala Univ. (Sweden). Inst. of Limnology.
Wilhelm Rodhe.
Verh Internat Verein Limnol, Vol 17, p 40-48 Nov 1969. 12 ref.

Descriptors: *Limnology, *Social needs, Ecosystems, Sampling, Seiches, Depth, Stratification, Winds, Temperature, Epilimnion, Thermocline, Hypolimnion, Phytoplankton, Chemical analysis, Zooplankton, Light penetration, Primary productivity, Carbon radioisotopes, Computer programs, Reservoirs, Political aspects, Eutrophication, Sewage, Effluents, Bottom sediments, Biochemical oxygen demand, Inorganic compounds, Nutrients, Lake Erie, Lake Ontario, Lake Michigan, Nitrogen, Productivity, Water quality, Industries, United Nations.
Identifiers: *Lake Kinneret (Israel), Beit Netufa (Israel), Winnipeg (Canada), Lake Zurich (Switzerland), Lake Baikal, Lake Washington (Wash), Seattle (Wash), Sweden, Lake Malaren (Sweden), World Health Organization.

In limnology each component is regarded a link in the ecosystem and the entire ecosystem a product of sources and surroundings. Sound water policy must be included in the social planning of every community and industry and the cost of clean waters must be met. The difficulty lies in the failure of politicians to recognize limnological advances and act on them on a global concept. Israel's Lake Kinneret Research Project requires regular sampling of basic data: three 'isothermal samples' at each station are necessary to represent lower epilimnion, steepest thermolcline, and upper hypolimnion, and, with samples close to the surface and bottom, make a weekly load of 35 samples from seven stations for chemical analyses and quantitative determinations of plytoplankton and zooplankton. At one station, a series of samples from 5 or 3 depths will be preserved for information concerning vertical distribution of plankton. Measurements of light penetration and carbon-14 exposures are made to determine primary production. Continuous meteorological and hydrological records are indispensable for interpretation of seiches and other dynamic phenomena. Augmentation of the study of Lake Kinneret and its tributaries with the work at MEKOROT laboratory at Beit Netufa reservoir is intended. (Jones-Wisconsin)
W70-03509

NITROGEN METABOLISM IN LAKES. II. ROLE OF NITROGEN FIXATION IN SANCTUARY LAKE, PENNSYLVANIA,
Pittsburgh Univ., Pa. Dept. of Biological Sciences.
For primary bibliographic entry see Field 05C.
W70-03511

THE SHAGAWA LAKE, MINNESOTA, EUTROPHICATION RESEARCH PROJECT,
Federal Water Pollution Control Administration, Corvallis, Oreg. Pacific Northwest Water Lab.
For primary bibliographic entry see Field 05C.
W70-03512

COMPARATIVE HYDROCHEMICAL CHARACTERISTIC OF RESERVOIRS - COOLERS OF STATE REGIONAL ELECTRIC POWER (HEAT) STATIONS OF THE UKRAINE (In Russian),
Akademiya Nauk URSR, Kiev. Instytut Hidrobiologii.
For primary bibliographic entry see Field 05C.
W70-03539

HORIZONTAL AND VERTICAL DISTRIBUTION OF TEMPERATURE, OXYGEN, pH AND WATER MOVEMENTS IN SLAPY RESERVOIR (1958-1960),
Ceskoslovenska Akademie Ved, Prague. Hydrobiological Station.
J. Hrbacek, and M. Straskraba.
Hydrobiological Studies 1, Academia Publishing House of the Czechoslovak Academy of Sciences, Prague, p 7-40, 1966.

Descriptors: *Temperature, *Reservoirs, Lakes, *Hypolimnion, Epilimnion, *Thermal stratification, Water circulation, Dissolved oxygen, Thermal properties, Alkalinity, Hydrogen low concentration, Water quality.
Identifiers: Czechoslovakian reservoirs, Slapy reservoir (Czechoslavakia).

The Slapy Reservoir on the Vltava River is narrow, long and deep, (mean width 313 m, length 42 km, max. depth 53 m). The ratio of volume to mean inflow indicates a mean renewal time of 38.5 days. A comparison of temperatures of the inflow, outflow and surface of the reservoir shows that the mean renewal time of the surface layers is much less than in lakes of a comparable drainage. During high flows, the release of water from the very deep layers is followed even in summer by horizontal currents, the velocity of which is at a distance of 9.1 km from the dam several decimeters per second. This characteristic of the deeper layers of the reservoir, when compared with lakes, is also manifested by an increase in oxygen in the deep layers during the second half of the summer, without inducing the homoiothermal conditions. (Novotny-Vanderbilt)
W70-03541

HYPOLIMNETIC HEATING IN CASTLE LAKE, CALIFORNIA,
California Univ., Davis. Dept. of Zoology.
For primary bibliographic entry see Field 05A.
W70-03551

2I. Water in Plants

ROOTING PATTERNS OF FOREST UNDERSTORY SPECIES AS DETERMINED BY RADIOIODINE ABSORPTION,
Montana Univ., Missoula. School of Forestry; and Montana Univ., Missoula. Dept. of Chemistry.
Thomas J. Nimlos, Wayne P. Van Meter, and Lewis A. Daniels.
ECOLOGY, Vol 49, No 6, p 1146-1151, Autumn 1968. 4 tab, 1 fig, 14 ref.

Descriptors: *Runoff, *Root zones, Root systems, Plant growth.
Identifiers: *Rooting patterns, *Understory plants, Radioiodine, Moisture regimes.

The rooting patterns of understory plants were determined with minimal disturbance of the site by injecting radioiodine into the soil and the beta and gamma activity of the aboveground tissue measured with a Geiger-Mueller detector. Injections were made to 72 inches in a clay, stone-free soils. Modifications of the procedure are required for injections to depths greater than 36 inches in stony soils. The procedure was applied to two sites of different moisture regimes. Many of the species studied rooted to 72 inches though the amount of aboveground tissue was only a few grams. Rooting on dry sites was deeper than at the more mesic site.
W70-03626

2J. Erosion and Sedimentation

LONGITUDINAL SLOPE CHARACTERISTICS OF RIVERS OF THE MIDCONTINENT AND THE ATLANTIC EAST GULF SLOPES,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02E.
W70-03255

A NEW RECORDING TURBIDITY METER FOR RIVERS,
Natal Univ., Durban (South Africa).
For primary bibliographic entry see Field 07B.
W70-03277

AN OPTICAL METHOD OF MEASURING GRAIN ORIENTATION IN SEDIMENTS,
Koninklijke-Shell Exploratie en Produktie Laboratorium, Rijswijk (Netherlands).
A. M. Winkelmolen, W. Van der Knaap, and R. Eijpe.
Sedimentology, Vol 11, No 3-4, p 183-196, Dec 1968. 14 p, 10 fig, 6 ref.

Descriptors: *Analytical techniques, *Particle shape, *Petrofabrics, Sediments, Optical properties, Petrography, Sedimentary rocks, Instrumentation, Photography, Sedimentary petrology.
Identifiers: Particle orientation, Optical techniques.

A new method for the measurement of grain orientation in clastic sediments is based on the principle that when an inclined beam of light passes through an elliptical hole in a plate, the amount of light passing through fluctuates with the orientation of the long axis of the ellipse. Such fluctuations are larger the greater the eccentricity of the ellipse, the amount of light passed being maximal when the long axis coincides with the plane of incidence of the light. If the plate contains many holes, which can be approximated by ellipses, their main orientation direction can be inferred from the maximum intensity of passed light. Results of a similar kind can be obtained by using a black and white picture of grain packing, obtained either from thin-sections or from printed replicas of etched polished sections of impregnated samples. The resulting data represent an integrated orientation pattern instead of a long-axis distribution pattern as given by the grain-by-grain counting technique. The new method has been thoroughly checked against the visual counting method. Excellent agreement was observed. (Knapp-USGS)
W70-03282

WEATHERING AND ROUNDNESS OF QUARTZ SAND GRAINS,
Australian National Univ., Canberra. Dept. of Geology.
Keith A. W. Crook.
Sedimentology, Vol 11, No 3-4, p 171-182, Dec 1968. 12 p, 1 fig, 3 plate, 21 ref, 1 append.

Descriptors: *Particle shape, *Sands, *Quartz, Solubility, Corrosion, Weathering, Diagenesis, Climates, Soil formation, Soil chemistry, Sediments, Sedimentary petrology.
Identifiers: Quartz grain solution.

Photographs and descriptions of quartz sand grains from soils, paleosols and silcretes show that grain shape can be modified by solution in situ. Dissolution is attributed to solutions rich in organic molecules present in weathering profiles, and commonly results in rounding of protuberances and reentrants on grains. The incidence of this process may vary with climate. It is postulated that solution rounding during weathering plays an important role in shaping quartz sand grains in general, its significance varying with climate. This postulate, which remains unconfirmed, has considerable implications for the interpretation of textural maturity of sandy sediments. If true, super-mature sands may be as much a climatic indicator as an indicator of tectonic quiesence. (Knapp-USGS)
W70-03283

INTERNAL STRUCTURE OF WAVE-FORMED RIPPLE MARKS IN THE NEARSHORE ZONE,
Kiel Univ. (Germany). Geological Inst.
For primary bibliographic entry see Field 02L.
W70-03284

DIAGENETIC RE-CRYSTALLIZATION AND ORIENTATION OF TWO CARBONATE SPECIES,
Durham Univ. (England). Dept. of Geology.
P. B. Attewell, D. M. Hirst, and R. K. Taylor.
Sedimentaology, Vol 11, No 3-4, p 237-247, Dec 1968. 11 p, 6 fig, 2 tab, 17 ref.

Descriptors: *Diagenesis, *Carbonate rocks, *Calcite, *Clay minerals, *Petrofabrics, Stratification, Beds, Stress, Pressure, Water chemistry, Laboratory tests, Petrology, Petrography, Sedimentary petrology.
Identifiers: Particle orientation, Recrystallization.

Results of X-ray textural studies of dolomite and the clay minerals in the Marl Slate and of siderite from the top of the Mansfield Marine Band are interpreted in terms of the possible diagenetic development of the re-crystallized carbonates in these two rocks. From computer processed fabrics of the two trigonal carbonates it is deduced that there is a c-axis preferred orientation concordant with the normal to the stratification. An early diagenesis in this oriented mode must be a function of both a threshold stress difference in a non-hydrostatic stress field (in effect a necessary minimum depth of burial) and also of the presence of connate solutions. The existence of a minor percentage of dolomite oriented with the rhomb faces parallel to the stratification probably reflects an even earlier crystallization within the top few meters of sediment, when the confining pressures and pressure differences were of insignificant amplitude. It is concluded that a higher rate of sedimentation associated with the Coal Measure sequence is responsible for the singular preferred orientation of the siderite. (Knapp-USGS)
W70-03285

X-RAY RADIOGRAPHY FOR EXAMINATION OF BURROWING IN SEDIMENTS BY MARINE INVERTEBRATE ORGANISMS,
Georgia Univ., Sapelo Island. Marine Inst.
James D. Howard.
Sedimentology, Vol 11, No 3-4, p 249-258, Dec 1968. 10 p, 5 fig, 17 ref.

Descriptors: *Sedimentary petrology, *Laboratory tests, *X-ray analysis, *Burrows, Aquatic animals, Sedimentary structures, Sediments, Deposition (Sediments).
Identifiers: Biotrbation.

Examination of the primary sedimentary texture of rocks and sediments by X-radiography can be extended to include the study of bioturbation and burrowing by living organisms. This technique involves making time-lapse X-radiographs while the animals are in the process of disturbing the sediment. Artificially and naturally stratified sediments are contained in plexiglass aquaria connected to a continuously flowing seawater system. The burrowing animals to be studied are introduced into these aquaria and the effect of their activities on the sediments is recorded by X-radiography over a period of hours, days or weeks. (Knapp-USGS)
W70-03286

PARTICLE SHAPE AND INFERENCE OF SIZE FROM SIEVING,
Gulf Research and Development Co., Pittsburgh, Pa.
John C. Ludwick, and Patricia L. Henderson.
Sedimentology, Vol 11, No 3-4, p 197-235, Dec 1968. 39 p, 11 fig, 1 plate, 7 tab, 21 ref.

Descriptors: *Particle size, *Sieve analysis, *Statistical methods, *Calibrations, Histograms, Frequency analysis, Probability, Mathematical models, Laboratory tests, Test procedures, Sedimentology, Sediments, Sands, Sedimentary petrology.
Identifiers: Sieve performance analysis.

Accurate particle-size measurement by sieving requires that consideration is given to particle shape and screen opening size variations. The effect of particle shape has been studied by determining experimentally the probability of passage through each of 5 woven-wire screens of 35 different mm-sized ellipsoids. These range in shape from T/D = 0.2 to 1.0 and from L/D = 1.125 to 2.625, where T is particle thickness, L is particle length, and D is particle intermediate diameter. A mathematical sieving theory stemming from the idea of particle passing probability is developed and tested by computer-simulated sieving of idealized input samples of simple shape composition. When near-spheres are sieved a bar-type histogram results. For some other more realistic shape inputs, broad, overlapping bell-shaped fraction distributions result, considerably different from the nominal openings of the limiting screens. For these distributions, conventional representation in histogram form is incongruous. (Knapp-USGS)
W70-03287

TEXTURAL STUDIES OF GRADING: VOLCANIC ASH FALLS,
Illinois Univ., Urbana; and Indiana Univ., Bloomington.
Adrian E. Scheidegger, and Paul Edwin Potter.
Sedimentology, Vol 11, No 3-4, p 163-170, Dec 1968. 8 p, 2 fig, 8 ref, 1 append.

Descriptors: *Aeolian soils, *Graded, *Beds, *Volcanoes, *Geomorphology, Aggradation, Deposition (Sediments), Sedimentation, Sedimentology, Stratification, Sedimentary structures, Sediment transport, Turbulent flow, Diffusivity, Sedimentary petrology.
Identifiers: *Graded bedding, *Ashfalls (Volcanic).

A theory of the lateral decrease of grain size and bed thickness with increasing distance of downwind transport is developed for ash falls. The theory is based on the sediment load density of a turbulent slug of fluid, a turbulent diffusivity coefficient, and the decay of turbulent velocity fluctuations. All three factors are founded on empirical observation and are generally accepted as having widespread applicability to turbulent sediment-fluid mixtures. The theory yields good qualitative agreement with observational data. (Knapp-USGS)
W70-03288

INTRICATED CROSS-STRATIFICATION DUE TO INTERACTION OF A MEGA RIPPLE WITH ITS LEE-SIDE SYSTEM OF BACKFLOW RIPPLES (UPPER-POINTBAR DEPOSITS, LOWER RHINE),
Utrecht Rijksuniversiteit (Netherlands). Geological Inst.; and State Geological Survey, Haarlem (Netherlands).
J. R. Boersma, E. A. Van de Meene, and R. C. Tjalsma.
Sedimentology, Vol 11, No 3-4, p 147-162, Dec 1968. 16 p, 9 fig, 9 ref.

Descriptors: *Ripple marks, *Dunes, *Sedimentary structures, *Sand waves, Currents (Water), Eddies, Vortices, Turbulent flow, Meanders, Bed load, Alluvial channels, Sediment transport, Channel morphology, Sedimentary petrology.
Identifiers: Megaripples, Rhine River, Cross-stratification, Forest beds.

Of several uncommon types of large-scale cross-stratification encountered in Late Holocene upper-pointbar sandy deposits of the Rhine, one is examined in detail. This type is structurally bipartite as it consists of a relatively coarse-grained, upper interval of large-scale foresets, which indentate with the oppositely dipping small-scale foresets in the underlying finer interval. The interwoven set is regarded as formed by a mega ripple (dune) with, in front of it, a simultaneously active system of small-scale, oppositely moving, ripples propelled by the backflow branch of the mega ripple's lee-side vortex. Comparison of dip, strike, and principal bedding-plane sections brought to light dissimilarity in the crestline orientations of the mega-ripple and backflow-ripple systems. The latter's oblique, or incidentally perpendicular orientation with respect to the mega-ripple front indicates a conspicuous component of lateral water movement, which in the present outcrop was consistent from left to right looking down stream. It is suggested that this lateral water movement is due to the radial (transverse) flow in the bend of a meandering river. From the sense of the radial flow the river's bend configuration can be inferred. (Knapp-USGS)
W70-03289

HEAVY MINERALS AND SIZE ANALYSIS OF THE CITRONELLE FORMATION OF THE GULF COASTAL PLAIN,
Louisiana State Univ., Baton Rouge.
Norman C. Rosen.
Journal of Sedimentary Petrology, Vol 39, No 4, p 1552-1565, Dec 1969. 14 p, 6 fig, 1 tab, 53 ref.

Descriptors: *Sedimentary petrology, *Provenance, *Mineralogy, *Mississippi River, *Gulf Coastal Plain, Geomorphology, Sedimentation, Sediment transport, Erosion, Particle size, Pleistocene epoch.
Identifiers: Heavy mineral analysis, Citronelle Formation.

The heavy minerals of the Citronelle Formation and fluviatile terraces of Louisiana were examined to determine the source of these sediments. An East Gulf Province heavy mineral suite (kyanite, staurolite, zircon, tourmaline), typical of the Cretaceous and Tertiary sediments of the Gulf Coastal Province is present throughout the Citronelle and older Louisiana terrace deposits. A Mississippi River province suite (epidote, dolomite, amphibole-pyroxene, garnet), presumably derived from the glacial deposits of the northern United States, is present in the younger Louisiana terrace deposits. The Citronelle Formation appears to represent an alluvial apron formed by coalescing, braiding streams in response to epeirogenic uplift of the continental interior during Late Pliocene to preglacial Pleistocene time. Encisement of the Mississippi River and other streams into Citronelle sediments resulted in entrenched valleys containing fluviatile terraces which are mineralogically and lithologically similar to the Citronelle but are at lower elevations. Younger terrace deposits bearing a Mississippi River province heavy mineral suite are believed to have formed in response to fluctuating sea level during the Pleistocene. (Knapp-USGS)
W70-03445

SUBAERIAL CEMENTATION AND SUBSEQUENT DOLOMITIZATION OF LACUSTRINE CARBONATE MUDS AND SANDS FROM PALEO-TUZ GOLU ('SALT LAKE'), TURKEY,
Heidelberg Univ., (West Germany). Sediment Research Lab.
German Muller, and Georg Irion.
Sedimentology, Vol 12, No 3/4, Special Issue, p 193-204, June 1969. 12 p, 11 fig, 7 ref.

Descriptors: *Dragenesis, *Carbonate rocks, *Dolomite, *Limestones, *Playas, Lakes, Water chemistry, Calcium, Magnesium, Carbonates, Chemical precipitation, Geochemistry, Sedimentary rocks.
Identifiers: *Turkey, Anatolia, Tuz Golu.

Along the eastern coast of the Gez Golu, a salt lake formerly belonging to the larger 'Paleo-Tuz Golu' in central Anatolia, about 6.5 m of lake sediments of probably Pleistocene age were studied. The sediment series consists of fine-grained unconsolidated dolomite muds representing the basin sedimentation of the old lake. Nine lithified beds (oomicrites, intramicrites, intraoomicrites, intrabiomicrites and dololutites with smaller amounts of allochems) are intercalated. These beds were deposited in very shallow water in the littoral zone of the paleo-lake. The beds were occasionally exposed to the air after deposition. This led to desiccation (with mud cracks, breaking up of intraclasts) and subaerial cementation due to the influx of fresh water. These now lithified carbonate sedimentary rocks were submerged and subsequently covered with mud. During this sub-aquatic phase the rock beds as well as the unconsolidated muds were dolomitized by an extremely high Mg/Ca-ratio (150/1) of the lake water. Dolomitization may have taken place or was initiated during the subaerial phase. (Knapp-USGS)
W70-03446

STRUCTURAL AND TEXTURAL EVIDENCE OF EARLY LITHIFICATION IN FINE-GRAINED CARBONATE ROCKS,
Technische Universitaet, Berlin (West Germany). Inst. of Geology and Paleontology.
H. Zankl.
Sedimentology, Vol 12, No 3/4, Special Issue, p 241-256, June 1969. 16 p, 7 fig, 28 ref.

Descriptors: *Diagenesis, *Carbonate rocks, *Water chemistry, Sedimentation, Chemical reactions, Calcium, Magnesium, Carbonates, Chemical precipitation, Geochemistry, Sedimentary rocks.
Identifiers: Carbonate sediment lithifications, Lime muds.

Absence of compaction, intraformational breccias, resedimentation, internal sediments and synsedimentary hardgrounds indicate early lithification of finegrained carbonate rocks. One of the factors controlling early lithification is the purity of lime mud. Less than 2% of insoluble residue (especially clay minerals) favors cementation and recrystallization before further sediment accumulation causes compaction. Thus, early lithification is terminated in or near the environment of sedimentation. Electrochemical reactions are considered to be possible mechanisms for cementation. (Knapp-USGS)
W70-03447

CONSOLIDATION AND SEDIMENTATION-COMPRESSION STUDIES OF A CALCAREOUS CORE, EXUMA SOUND, BAHAMAS,
Illinois Univ., Urbana. Dept. of Geology.
For primary bibliographic entry see Field 08E.
W70-03448

SEDIMENT INVESTIGATION IN BIG SAND COULEE BASIN, WYOMING AND MONTANA,
Geological Survey, Worland, Wyo
Hugh W. Lowham
Geological Survey Open-file Report, Nov 1969. 20 p, 7 fig, 2 tab.

Descriptors: *Sediment transport, *Bed load, *Montana, *Wyoming, Sands, Sedimentation, Erosion, Sediment yield, Irrigation water, Return flow, Streamflow, Scour, Silting.
Identifiers: Big Sand Coulee (Wyo-Mont).

The erosion of streambanks and basin surface by storm and snowmelt runoff provides large amounts of sediment to streams in the Big Sand Coulee basin, Montana and Wyoming. Some sediment is carried into the Clarks Fork Yellowstone River and some is deposited in the channel of Big Sand Coulee. Small amounts of sediment are brought into the Big Sand Coulee by waste waters from the Heart Mountain Irrigation Project and from other irrigated lands. These waters pick up sediment from the streambed of Big Sand Coulee and transport it downstream but do not appear to be causing any accelerated erosion. Waste waters, return irrigation water, and groundwater inflow maintain a continuous flow and transport sediment continuously into Clarks Fork Yellowstone River. (Knapp-USGS)
W70-03457

VISUAL OBSERVATIONS OF MANGANESE DEPOSITS ON THE BLAKE PLATEAU,
Naval Oceanographic Office, Washington, D.C. Deep Vehicles Branch.
Larry K. Hawkins.
Journal of Geophysical Research, Vol 74, No 28, p 7009-7017, Dec 20, 1969. 9 p, 10 fig, 6 ref.

Descriptors: *Deposition (Sediments), *Manganese, *Oceans, Sea water, Submarines, Topography, Phosphates, Currents (Water), Mapping, Waves (Water), Geology, Carbonates, Environment.
Identifiers: Blake plateau, Submarine manganese deposits.

Visual observations of manganese deposits on the Blake plateau from a manned submersible indicate that the occurrence of manganese as nodules, slabs, or pavement may be related to localized environmental conditions. Manganese is concentrated at the crests of sand waves and, in areas of gentle slope, grades locally from nodules to solid pavement. (Gabriel-USGS)
W70-03462

THE EFFECT OF FRESH WATER ON THE REDISTRIBUTION OF URANIUM IN CARBONATE SEDIMENTS,
Rensselaer Polytechnic Inst., Troy, N.Y. Dept of Geology.
For primary bibliographic entry see Field 02K.
W70-03468

GEOLOGICAL AND MINERALOGICAL STUDIES OF SOME SAND DEPOSITS IN THE NILE DELTA, U.A.R.,
National Research Center, Cairo (Egypt). Earth Science Lab.
For primary bibliographic entry see Field 02L.
W70-03469

A NON-DESTRUCTIVE CORE ANALYSIS TECHNIQUE USING X-RAYS,
Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Geology.
For primary bibliographic entry see Field 07B.
W70-03470

IRON-RICH LAYERS IN SEDIMENTS FROM THE GULF OF MEXICO,
Texas Instruments, Inc., Dallas; and Kansas Univ., Lawrence. Dept. of Civil Engineering.
Jerry A. Watson, and Ernest E. Angino.

Journal of Sedimentary Petrology, Vol 39, No 4, p 1412-1419, Dec 1969. 8 p, 4 fig, 2 tab, 18 ref.

Descriptors: *Sediments, *Diagenesis, *Iron, Geochemistry, Gulf of Mexico, Water chemistry, Stratification, Sea water, Manganese, Cobalt, Trace elements, Pleistocene epoch, Carbon radioisotopes, Cores, Climates, Geology, Mapping, Analytical techniques, Statistical studies, Sampling, Carbonates.
Identifiers: Iron-rich sediments.

Thin yellow layers (0.5 to 2 cm) examined in seven cores in the west and central portions of the Gulf of Mexico are enriched in iron, manganese, cobalt, and nickel with respect to the surrounding sediments. The average enrichment is 66, 33, 51, and 28 percent, respectively. The highest correlation coefficients between single pairs of elements yield Co:Ni (r =0.53), Fe:Ni (0.64), Fe:Co (0.62), and Mn:Co (0.50). The yellow, iron-rich sediments commonly occur in the Pleistocene-Holocene transition zone and in the upper Pleistocene sediments. The iron-rich zones are considered to be the result of a reduced sediment accumulation rate. Carbon-14 dates support this argument. The close association with iron-stained foraminiferal tests in the sediments suggests post-depositional scavenging. The yellow layers are most prevalent on the lower continental slope, continental rise, and Sigsbee abyssal plain. (Gabriel-USGS)
W70-03471

A GRAIN SIZE ANALYSIS OF LONGSHORE-BARS AND TROUGHS, LAKE SUPERIOR, ONTARIO,
Lakehead Univ., Port Arthur (Ontario).
For primary bibliographic entry see Field 02H.
W70-03472

RECENT SEDIMENTATION IN NORTHERN CARDIGAN BAY, WALES,
Wisconsin Univ., Madison.
For primary bibliographic entry see Field 02L.
W70-03478

RECENT SEDIMENTATION IN THE BERING SEA,
Akademiya Nauk SSSR. Institut Okeanologii.
For primary bibliographic entry see Field 02L.
W70-03500

THE EFFECT OF A PERMEABLE SAND BED ON SEDIMENT MOTION,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
C. Samuel Martin, and Mustafa M. Aral.
Available from the Clearinghouse as PB-189 404, $3.00 in paper copy, $0.65 in microfiche. Water Resources Center, Georgia Institute of Technology, Completion Report WRC-0869, Nov 1969. 97 p, 2 tab, 46 fig, 20 ref, 1 append. OWRR Project B-019-GA.

Descriptors: *Sediment transport, *Seepage, *Sediment-water interfaces, *Permeable beds, *Stream-beds, *Slope stability, *Bed load, Porous media, Permeability, Sediment load, Suspended load, Porosity, Stream channel erosion.

The research objectives were to determine the criterion governing incipient sediment motion when a plane bed is subject to seepage through it and boundary-layer flow over it, and to determine the effect of the seepage force on sediment transport. Slope instability tests were conducted with seepage flow into and out of the bed using two sand columns, one square and the other circular in cross section. For uniform sand particles ranging from 0.46 mm to 0.72 mm in diameter, the seepage force on the interfacial sand grains was determined to be one-half the seepage force on particles well within the bed. Incipient-motion tests indicate that seepage may either enhance or hinder incipient motion, depending on the relative magnitude of the boundary shear stress and seepage force, both of which depend on seepage flow. For a given hydraulic gradient for seepage into a bed the size of the sand grains is critical regarding incipient motion. Incipient motion may be hindered for smaller sand grains but enhanced for larger sand grains. Seepage into a sand bed was found to not measurably impair sediment transport, unless fine particles are deposited in the bed. For practical values of hydraulic gradient, that is less than unity, the effect of seepage on incipient motion and sediment transport is not significant. (Conway-Georgia Tech)
W70-03617

2K. Chemical Processes

NONIONIC POLYMER FLOCCULATION OF DILUTE CLAY SUSPENSION,
Maryland Univ., College Park. Dept of Civil Engineering; and Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 05A.
W70-03265

QUALITY OF SURFACE WATERS OF SOUTH CAROLINA: A SUMMARY OF DATA, 1945-1968,
Geological Survey, Columbia, S.C.
For primary bibliographic entry see Field 05B.
W70-03266

THE CONCEPT OF ENERGY EFFICIENCY IN PRIMARY PRODUCTION,
Fisheries Research Board of Canada, Dartmouth (Nova Scotia). Bedford Inst. Lab.
Trevor Platt.
Limnology and Oceanography, Vol 14, No 5, p 653-659, Sept 1969. 2 fig, 2 tab, 10 ref.

Descriptors: *Primary productivity, *Photosynthesis, Solar radiation, Oceanography, Chlorophyll, Regression analysis, Estimating equations, Photometry, Biomass, Carbon radioisotopes, Fluorometry, Correlation analysis, Inhibition, Environmental effects, Nutrients, Temperature, Light intensity.
Identifiers: *Energy efficiency, Optical extinction coefficient, Depth effects, St Margaret's Bay (Nova Scotia), Nova Scotia, Canada, Precision, Error analysis, Extinction coefficients, Biological processes, Photobiology, Biological extinction coefficients, Radiocarbon uptake technique, Chlorophyll a, Coscinodiscus excentricus, Raritan Bay (Canada), Assimilation quotients, Chemical processes.

Establishment of truly dimensionless measures of energy efficiency may make possible the comparison of primary productivity of water masses. Coefficient, k-sub-b, which measures the contribution of photosynthetic processes to the total optical extinction coefficient is defined. Based on theoretical considerations and first-order simplifying approximations, k-sub-b, at any depth, is shown to be equivalent to the ratio, primary production to incident radiation at that depth, where each is expressed in calories. Values for k-sub-b, calculated for two stations in St Margaret's Bay, Nova Scotia, show that the coefficient, at any depth, is linearly dependent on concentration of chlorophyll a at that depth. Errors in estimating k-sub-b include errors in measurement of energy fixed, of incident radiation at water's surface, and of optical extinction coefficient. Precision in estimating k-sub-b would be improved by measurement of incident radiation at any depth with an in situ integrating radiometer. K-sub-b may represent a useful index for comparison of primary productivity of waters, and that its regression on concentration of chlorophyll a can be used as a predictive tool in studies of production. (Eichhorn-Wisconsin)
W70-03313

OCCURRENCE AND SIGNIFICANCE OF IRON, MANGANESE, AND TITANIUM IN GLACIAL MARINE SEDIMENTS FROM THE ESTUARY OF THE ST LAWRENCE RIVER,
Fisheries Research Board of Canada, Dartmouth (Nova Scotia). Bedford Inst.
D. H. Loring, and D. J. G. Nota.
Journal Fisheries Research Board of Canada, Vol 25, No 11, p 2327-2347, 1968. 5 fig, 4 tab, 26 ref.

Descriptors: *Sediments, Iron, Manganese, Titanium, Oxidation-reduction potential, Erosion, St Lawrence estuary, Glacial soils, Estuaries.
Identifiers: Sediment texture, Oxide films, Detrital minerals, Canadian Shield, Marine sediments.

Investigations of glacial marine sediments of Canadian Shield origin revealed small but significant modification of iron and manganese-bearing material produced by the present physicochemical conditions. Titanium was not affected by environmental influences. The content of elements was related to the texture of sediments, increasing in small-size fractions. (Wilde-Wisconsin)
W70-03320

OXYGENATION OF FERROUS IRON: THE RATE-DETERMINING STEP IN THE FORMATION OF ACIDIC MINE DRAINAGE,
Harvard Univ., Cambridge, Mass. Dept. of Applied Chemistry.
For primary bibliographic entry see Field 05B.
W70-03434

STRUCTURAL AND TEXTURAL EVIDENCE OF EARLY LITHIFICATION IN FINE-GRAINED CARBONATE ROCKS,
Technische Universitaet, Berlin (West Germany). Inst. of Geology and Paleontology.
For primary bibliographic entry see Field 02J.
W70-03447

OCCURRENCE AND QUALITY OF GROUNDWATER IN SHACKELFORD COUNTY, TEXAS,
Texas Water Development Board, Austin.
For primary bibliographic entry see Field 02F.
W70-03460

VARIATION IN THE MEAN DEUTERIUM CONTENT OF PRECIPITATIONS IN ANTARCTICA,
Centre National de la Recherche Scientifique, St. Cloud (France).
For primary bibliographic entry see Field 02C.
W70-03461

THE EFFECT OF FRESH WATER ON THE REDISTRIBUTION OF URANIUM IN CARBONATE SEDIMENTS,
Rensselaer Polytechnic Inst., Troy, N.Y. Dept of Geology.
David S. Haglund, Gerald M. Friedman, and Donald S. Miller.
Journal of Sedimentary Petrology, Vol 39, No 4, p 1283-1296, Dec 1969. 14 p, 14 fig, 4 tab, 23 ref. NSF Grants GP 2691 and GP 5169.

Descriptors: *Diagenesis, *Uranium radioisotopes, *Carbonate rocks, *Sediments, Carbonates, Sampling, Geology, Sands, Calcite, Limestones, Carbon radioisotopes, Pleistocene epoch, Stratigraphy, Mineralogy, Recent epoch, Geochemistry.
Identifiers: *Bermuda, Israel.

Recent carbonate sands and their ancient analogs were studied in Bermuda and Israel in order to establish the effect of fresh water alteration on the distribution of uranium. The uranium and calcite concentrations show an inverse relation and indicate that calcite, the product of fresh water alteration, accepts less uranium than the original aragonite. The relationship between uranium and stable carbon and oxygen isotopes for the Bermuda samples is inconclusive, whereas the same plots for the Israeli Coast samples show a direct relationship between decreasing uranium content and increasingly negative delta values. In general as the

metastable minerals aragonite and Mg-calcite are removed from the sediment system in the change from unconsolidated carbonate sand to consolidated limestone, there is a concomitant decrease in uranium content. (Gabriel-USGS)
W70-03468

DETERMINATION OF MICROGRAMME QUANTITIES OF DISSOLVED SULPHATE IN SURFACE WATERS, SOILS AND PLANTS,
Commonwealth Scientific and Industrial Research Organization, St. Lucia (Australia). Cunningham Lab.
For primary bibliographic entry see Field 05A.
W70-03502

2L. Estuaries

FISH AND POWER PLANTS,
New York State Dept. of Conservation, Albany. Div. of Marine and Coastal Resources.
For primary bibliographic entry see Field 05C.
W70-03250

FLOW OF FRESH WATER TO DRAINS IN A COASTAL AQUIFER,
Asian Inst. of Technology, Bangkok (Thailand). Dept. of Engineering.
For primary bibliographic entry see Field 04B.
W70-03257

ON THE STRUCTURE OF HIGH-FREQUENCY TURBULENCE IN A TIDAL ESTUARY,
John Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
W. J. Wiseman, Jr.
Chesapeake Bay Institute Technical Report 59, Reference 69-12, Johns Hopkins University, Nov 1969. 76 p, 19 fig, 1 tab, 36 ref, 1 append. Navy Proj No NR 083-016, Office of Naval Research Contract nonr 4010 (11).

Descriptors: *Current meters, *Turbulence, *Vortices, *Estuaries, Currents (Water), Streamflow, Calibrations, Instrumentation, Water circulation.
Identifiers: Doppler current meters, Acoustic current meters, Chesapeake Bay.

As part of a program to study naturally occurring fluid motions in the marine environment a meter was developed to sense high-frequency turbulence. The meter does not disturb the fluid at the point of measurement. It measures the entire velocity vector and it takes a vector average of measurements. The meter has been laboratory tested and used in the field. During the field tests, the conditions under which it was operated were far from optimal, but some useful data were obtained. At the small time scales involved there may exist significant vertical velocities in an estuary. The energy in the vertical turbulent fluctuations was less than in either horizontal direction. This rules out the possibility of isotropic turbulence at these scales of motion, for the estuarine conditions sampled. The current meter has the capability of operating effectively in the presence of a wave field. (Knapp-USGS)
W70-03259

TIDAL RELATIONS IN THE SOUTH BISCAYNE BAY AREA, DADE COUNTY, FLORIDA,
Geological Survey, Tallahassee, Fla.
James J. Schneider.
Geol Surv Open-file Report, Jan 1969. 16 p, 6 fig, 1 tab.

Descriptors: *Tides, *Florida, *Bays, Inlets (Waterways), Sea level, Urbanization, Shores, Tidal waters, Water levels, Water level fluctuations, Surveys, Data collections, Hydrologic data.
Identifiers: Dade County (Fla), Miami (Fla).

Development of the waterfront lands of southeast Dade County depends upon the construction of sea walls (bulkheads) and filling of the lowlying land. To assist Dade County officials in planning the development of the area, an investigation was made to determine the elevation of mean high water and tidal patterns in the south Biscayne Bay area. The results of the investigation are based on records collected from 10 tide gages during the period July 1, 1967 through June 30, 1968. Prior records from most of the gages were available for correlation. The elevation of mean high water was 1.5 feet in central Biscayne Bay and 0.9 ft in the lower bays. The mean tidal range was 2.0 ft in central Biscayne Bay and 0.5 ft in the lower bays. The difference between mean half tide and mean water level was found to be negligible at all stations. The time lag for high and low tides, referred to Miami Beach, was approximately one hour in Biscayne Bay and 6 hours at Manatee Bay. (Knapp-USGS)
W70-03268

WATER QUALITY IN THE DRAINAGE AREA OF THE DELAWARE RIVER (DUTCH),
Rijksinstituut voor Zuivering van Afvalwater, Voorburg (Netherlands).
For primary bibliographic entry see Field 05B.
W70-03269

INTERNAL STRUCTURE OF WAVE-FORMED RIPPLE MARKS IN THE NEARSHORE ZONE,
Kiel Univ. (Germany). Geological Inst.
Robert S. Newton.
Sedimentology, Vol 11, No 3-4, p 275-292, Dec 1968. 18 p, 7 fig, 2 plate, 1 tab, 27 ref.

Descriptors: *Ripple marks, *Waves (Water), *Sedimentary structures, Sedimentary petrology, Sedimentation, Sediment transport, Currents (Water), Sand waves, Tracers, Tracking techniques, Bed load.
Identifiers: Nearshore ripple marks.

Wave-formed ripple marks in the nearshore zones of the Baltic Sea (tideless) and North Sea (tidal) exhibit a unidirectional internal lamination identical to that of current ripples. This holds true whether the ripples are symmetrical or asymmetrical. In most cases wave-formed ripple laminae dip toward shore and can thereby provide a shoreline direction indicator when found in ancient sediments. The sediment transport direction, however, may be other than in the foreset laminae dip direction, and cross-lamination as a sediment transport direction indicator should be used with caution. Ripple height, wave length and the orientation of the ripple internal structure are dependent upon both the orbital diameter and the velocity of the positive component of oscillation of the waves forming them. The thickness of the individual laminae making up ripples is highly dependent upon sediment grain size; the role hydrodynamics plays is problematic. (Knapp-USGS)
W70-03284

CLEANING OIL CONTAMINATED BEACHES WITH CHEMICALS, A STUDY OF THE EFFECTS OF CLEANING OIL CONTAMINATED BEACHES WITH CHEMICAL DISPERSANTS.
Federal Water Pollution Control Administration, Edison, N.J. Northeast Region Research and Development Program.
For primary bibliographic entry see Field 05C.
W70-03349

MARITIME CONTIGUOUS ZONES,
For primary bibliographic entry see Field 06E.
W70-03381

CONSERVATION OF NATURAL RESOURCES (SHORE EROSION).
For primary bibliographic entry see Field 04D.
W70-03405

HEAVY MINERALS AND SIZE ANALYSIS OF THE CITRONELLE FORMATION OF THE GULF COASTAL PLAIN,
Louisiana State Univ., Baton Rouge.
For primary bibliographic entry see Field 02J.
W70-03445

NEPHELOID LAYERS AND BOTTOM CURRENTS IN THE ARCTIC OCEAN,
Lamont-Doherty Geological Observatory, Palisades, N.Y.
Kenneth Hunkins, Edward M. Thorndike, and Guy Mathieu.
Journal of Geophysical Research, Vol 74, No 28, p 6995-7008, Dec 20, 1969. 14 p, 8 fig, 3 tab, 15 ref. ONR Contracts Nonr 266 (82) and N00014-67-A0108-0016.

Descriptors: *Ocean currents, *Currents (Water), *Optical properties, *Turbidity, Instrumentation, Arctic Ocean, Photography, Suspension, Turbulent flow, Velocity, Topography, Water Circulation, Surface waters, Deep water, Organic matter, Mapping, Sounding, Transmissivity, Mathematical studies, Suspended load.
Identifiers: Nepheloid layers (Oceanography), Nephelometry.

Light scattering from nepheloid layers of the Arctic Ocean was investigated by using nephelometers and echo sounding. The zone of deep light scattering over oceanic ridges and rises is called the bottom nepheloid layer. At all the observation stations the strongest scattering occurred near the surface, decreasing with depth in the upper layers. The bottom nepheloid layer is evidently caused by fine material that is maintained in suspension by turbulent flow. Swifter current speeds occur over the ridges and suggest a counterclockwise deep circulation in the Canada basin. (Gabriel-USGS)
W70-03463

GEOLOGICAL AND MINERALOGICAL STUDIES OF SOME SAND DEPOSITS IN THE NILE DELTA, U.A.R.,
National Research Center, Cairo (Egypt). Earth Science Lab.
M. M. Kholief, E. Hilmy, and A. Shahat.
Journal of Sedimentary Petrology, Vol 39, No 4, p 1520-1529, Dec 1969. 10 p, 6 fig, 5 tab, 37 ref.

Descriptors: *Sedimentary petrology, *Deltas, *Estuaries, *Sediments, *Sands, Mineralogy, Geology, Rivers, Sampling, Mapping, Environment, Alluvium, Silts, Clays, Particle size, Statistical methods, Chemical analysis.
Identifiers: Nile Delta.

Samples of sediments from the Nile Delta were investigated by mechanical, chemical, and mineralogical analyses. Sand islets have a general lithologic uniformity and are commonly characterized by graded bedding and ripple marks. The sands are from moderately to well sorted and exhibit no significant differences in the mean roundness of grains. Small amounts of iron oxide and carbonates coat the quartz grains. Two heavy mineral assemblages were found. (Gabriel-USGS)
W70-03469

IRON-RICH LAYERS IN SEDIMENTS FROM THE GULF OF MEXICO,
Texas Instruments, Inc., Dallas; and Kansas Univ., Lawrence. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02J.
W70-03471

CATALOG OF TSUNAMIS IN THE HAWAIIAN ISLANDS,
Coast and Geodetic Survey, Rockville, Md.
George Pararas-Carayannis.
Available from US Dept of Commerce, Environ Sci Serv Admin, Coast and Geodetic Survey. World Data Center A Rep WDCA-T 69-2, May 1969. 94 p, 2 tab, 146 ref, index.

Descriptors: *Tsunamis, *Hawaii, *Data collections, *Bibliographies, Ocean waves, Waves (Water), Earthquakes, Pacific Ocean.
Identifiers: World Data Center.

All available data pertaining to tsunamis in the Hawaiian Islands are compiled. An extensive bibliography is included. All the available information has been compiled from historical accounts, newspaper archives, other reports, and recent mareographic data. Most of the events listed are associated with earthquakes, but some are associated with volcanic activity. Others, which do not show an association with earthquakes near the places of observation, may have been tsunamis of distant seismic origin for which there is no record. Most of the destructive tsunamis in the Hawaiian Islands have been generated along the coast of South America, the Aleutian Islands, the Kamchatka Peninsula, and Japan. The number of locally generated tsunamis is very small. (Knapp-USGS)
W70-03476

RECENT SEDIMENTATION IN NORTHERN CARDIGAN BAY, WALES,
Wisconsin Univ., Madison.
J. Robert Moore.
Bulletin of the British Museum (Natural History), Mineralogy Series, Vol 2, No 2, p 21-131, Feb 1968. 110 p, 47 fig, 7 tab, 70 ref.

Descriptors: *Sedimentation, *Estuaries, *Bays, Petrography, X-ray analysis, Mineralogy, Chemical analysis, Trace elements, Geochemistry, Streams, Sands.
Identifiers: *Cardigan Bay (Wales).

Marine sediments in the shallow waters of northern Cardigan Bay, Wales, are dominantly fine-grained sands that have been well sorted by active tidal and longshore currents. Minor accumulations of bimodal deposits of sand and gravel are present near the sarns, and at the base of the eroding coastal cliffs. The bay deposits are composed of 6 common minerals: quartz, muscovite, chlorite, orthoclase, plagioclase, and calcite. Rarely, minor amounts of dolomite are present. Based on their gross mineral content, the deposits are classified as quartzose sands, with a few being subgreywackes, or sublithic sands. Charted dispersal patterns indicate local sources along the coast, namely eroding exposures of glacial debris and sea-cliffs of slates and greywackes. Spectrochemical data are reported, and elemental distributions in the bay sediments charted. Distribution patterns of certain elements associated with accessory minerals define zones of tidal currents, while elements related to aluminosilicates largely indicate the locations of eroding coastal exposures currently supplying detritus to the bay. Most of the bay sands are derived from coastal erosion sites and not from sources inland; streams are not active suppliers of sand to the bay; estuaries are being infilled from the sea; net transport of sediment is northward inshore, but seaward, in part, offshore; and that the present bay sands would have the desirable features of a reservoir rock if they were buried in the subsurface. (Gabriel-USGS)
W70-03478

RECENT SEDIMENTATION IN THE BERING SEA,
Akademiya Nauk SSSR. Institut Okeanologii.
A. P. Lisitsyn.
CFSTI Translation No TT 68-50315, 1966. 614 p, 187 fig, 102 tab, 544 ref.

Descriptors: *Sedimentation, *Marine geology, Analytical techniques, Sampling, Mapping, Climates, Permafrost, Continental shelf, Continental slope, Soils, *Glaciation, Water chemistry, *Bottom sediments, Mineralogy, Petrography, Organic matter, Biogeography.
Identifiers: Bering Sea, Recent sedimentation.

The Bering Sea is one of the largest marine basins of the globe, with an area of 2,257,541 sq km. It is also the deepest sea washing the shores of the USSR. It has a maximum depth of 4,420 m, equal to the mean depth of the Pacific and exceeding the mean depth of the World Ocean. The Bering Sea lies on the boundary between the glacial and the temperate zones. It is probably singular in this respect, making possible studies of all the details of sedimentation in these zones and the transition regions between them, as well as research into the variations of the positions of these zones in the geological past. The depth of the Kamchatka Strait exceeds the maximum depth of the sea so that Pacific Ocean waters penetrate throughout this basin. The narrow and shallow Bering Strait connects the Bering Sea with the Arctic Ocean. Its maximum depth is only 58 m, its average depth 30-50 m, and its width 85 km, and at times of low sea level the strait may have been a land bridge to North America. Marine conditions are most distinct in the northern and eastern parts of the sea, while oceanic conditions dominate in the deep basins in its southern part. The Bering Sea lies within the northern belt of Pacific diatomaceous oozes. It is therefore possible to study the results of combined effects of terrigenous and biogenic siliceous sedimentation. (Gabriel-USGS)
W70-03500

DISCUSSION OF 'TURBULENT MIXING PHENOMENA OF OCEAN OUTFALLS' BY R. FRANKEL AND J. CUMMING,
California Inst. of Tech., Pasadena, Calif. W. M. Keck Lab. of Hydraulics and Water Resources.
For primary bibliographic entry see Field 08B.
W70-03553

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

REVIEW AND ANALYSIS OF THE COSTS OF DESALTED SEA WATER,
Massachusetts Inst. of Tech., Cambridge. Dept. of Economics; and Massachusetts Inst. of Tech., Cambridge. Alfred P. Sloan School of Management.
F. J. Wells, and P. W. MacAvoy.
Department of State, Office of Water for Peace Report, 1969. 106 p, 14 fig, 11 tab, 30 ref, 3 append.

Descriptors: *Desalination plants, *Cost analysis, *Water costs, Economics, Economies of scale, Desalination processes, Capital costs, Construction costs, Electric power costs, Maintenance costs, Operating costs, Total costs, Cost comparisons, Discount rate.
Identifiers: Desalination costs.

A survey and an analysis were made of sea water desalination costs estimates contained in a number of source documents. These water costs components were tabulated, and then plotted in graphs as a function of plant capacity. Even for similar sized plants, wide ranges of costs were observed within most of these cost categories. Tables of results are given for the following conditions: Near-Term (MSF) Unit Water Costs; 10,000, and 1000 mgd plant sizes; 0, 3, 6, 9, and 12% interest rates; 30 year plant life; 60, 70, 80, and 90% plant load factors; 30 cents per million BTU fossil fuel cost. (Knapp-USGS)
W70-03453

RECONNAISSANCE APPRAISAL OF THE WATER RESOURCES NEAR ESCALANTE, GARFIELD COUNTY, UTAH,
Utah Univ., Salt Lake City. Dept. of Geological and Geophysical Sciences.
For primary bibliographic entry see Field 02F.
W70-03454

SURFACE PROPERTIES OF TEFLON FILM IN SALINE WATER PROCESSES,
Nebraska Univ., Lincoln. Water Resources Research Inst.
Luh C. Tao, Richard Myers, and Dennis Kos.
Available from the Clearinghouse as PB-189 403, $3.00 in paper copy, $0.65 in microfiche. Water Resources Research Institute Project Completion Report, Nebraska University, Jan 24, 1969. 21 p, 5 fig, 3 tab, 8 ref. OWRR Proj No A-010-NEB.

Descriptors: *Films, *Saline water, *Scaling, Heat transfer, Calcium sulfate, Evaporators, Research and development, Coatings, Boilers, Feeding rates.
Identifiers: Polyfluorocarbon boiler-tube coatings.

Desalination evaporator scaling was considerably reduced by a thin polyfluorocarbon coating on boiler tubes. Coatings of 'McLube', made by McGee Chemical Company, less than 0.001-inch thick improved the heat transfer rate about 70% to 130% relative to the uncoated tubes. The initial small boiler was then modified in order to allow continuous feed of calcium sulfate solutions. The coating performance exhibited more improvement with (1) moderate feed rates of salt solution and (2) high temperature difference across the tube wall. The results from the small boiler were confirmed in a larger pilot scale boiler. The feasibility of using a low-adhesion coating to reduce scaling on evaporators has been established. Further study on durability of coatings and possible combination with seeding the feed solution is recommended. (Carstea-USGS)
W70-03646

3B. Water Yield Improvement

BASE-FLOW STUDIES OF LEON AND LAMPASAS RIVERS, TEXAS - QUANTITY AND QUALITY, JANUARY 16-17, 1968,
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02E.
W70-03466

DIVISION OF WATER DEVELOPMENT.

NJ Stat Ann secs 58:19-4 to 58:19-8 (1966).

Descriptors: *New Jersey, *Reservoirs, *Administrative agencies, *Water supply, Dams, Water works, Planning, Water control, Legislation, Regulation, Government finance, Rivers, River flow, Gaging stations, Dam construction, Projects, Project planning, Project purposes, Domestic water, Industrial water.

The Division of Water Development is created in the Department of Conservation and Economic Development and shall consist of a five-member Board appointed by the Governor. The members shall serve without compensation for terms of from one to four years. The Board shall acquire and operate a water supply system to be known as the New Jersey Water Supply System. The System shall include a reservoir near Chimney Rock in Somerset County adequate to initially yield 70,000,000 gallons daily. Upon further authorization from the legislature the yield shall be increased to 200,000,000 gallons daily. Other reservoirs and facilities to provide increased water supply for domestic and industrial uses are authorized. The Board may expend $60,000,000 from the proceeds of the New Jersey Water Supply Bond Act for construction of the Chimney Rock Reservoir and compensating facilities on the Raritan River to assure a minimum daily flow of 130,000,000 gallons to be measured at the Bound Brook gaging station. Remaining funds under the Act may be expended as specifically authorized by law for planning, water supply investigations, and additional facilities. (Kahle-Florida)
W70-03491

3D. Conservation in Domestic and Municipal Use

WATER SUPPLY, SANITATION, AND DITCHES (COUNTY WATER SUPPLY SYSTEMS).
Ohio Rev Code Ann secs 6103.06-6103.30 (Page 1953), as amended, (Supp 1970), secs 6103.081, 6103.31 (Supp 1970).

Descriptors: *Ohio, *Water supply, *Water management (Applied), Water works, Utilities, Water distribution (Applied), Financing, Legislation, State governments, Administrative agencies, Regulation, Local governments, Sanitary engineering, Public health, Legal aspects, Sewage districts.

Procedures for the construction of proposed improvements by water supply districts are outlined in the statute. The board of county commissioners may issue and sell bonds to finance the improvement. Bids are let for the construction of the improvement to be accepted or rejected by the board. A petition to waive procedural safeguards to hasten construction may be made to the board by the landowners to be benefitted. All property benefitted by the improvement shall be ratably assessed. Methods and terms of assessment payments are outlined. Certification of assessments are made by the county auditor. The Department of Health can require improvements to be made by the board, if they believe that unsafe water conditions exist in the county. Such demands are subject to court review. Water may be supplied beyond the district. Existing private water works of good quality may be purchased by the board. Eminent domain proceedings may be brought or property may be purchased when land is needed by the board to effect the provisions of this act. (Barnett-Florida)
W70-03397

WATER RESOURCES.
For primary bibliographic entry see Field 06B.
W70-03421

ACQUISITION OF LAND TO PREVENT CONTAMINATION.
For primary bibliographic entry see Field 05G.
W70-03532

3E. Conservation in Industry

OIL AND GAS.
For primary bibliographic entry see Field 08G.
W70-03425

THE ECONOMIC VALUE OF WATER IN INDUSTRIAL USES,
Rice (Cyrus Wm.) and Co., Pittsburgh, Pa.
For primary bibliographic entry see Field 06C.
W70-03431

COST HANDBOOK FOR INDUSTRIAL WATER USES,
Rice (Cyrus Wm.) and Co., Pittsburgh, Pa.
For primary bibliographic entry see Field 06C.
W70-03432

WATER SUPPLY TO THERMAL POWER PLANTS,
Sargent and Lundy, Chicago, Ill.
E. J. Stankiewicz.
Journal of Power Division, Proceedings of the ASCE, Paper 1889, p 1-23, Dec 1958. 14 fig.

Descriptors: *Cooling water, *Thermal power plant, Condensers, Cooling towers, Pipes.
Identifiers: Closed circulation system, Direct circulation system, Circulating water pumps, Spray ponds, Crib houses, Cooling ponds.

Water supply to thermal power plants is the chief factor in locating plant sites, because of cooling water requirements, and accounts for the largest single nationwide water use. Total thermoelectric capacity of the country for 1957 was 102 million kw, with a 0.59 capacity use factor, condenser cooling water amounts to 70 billion gallons per day, equivalent to 27% of our total national use of 261 billion gallons. Sources of circulating water supply maybe natural or man-made. Two basic types of circulating water systems are direct circulation and closed circulation. In the direct circulation system, water is pumped directly from source to condenser and is discharged downstream of the source. Over 70% by water use was direct circulation in 1957. Examples of each type of use are given. There is no reuse of water in direct circulation. Arrangement of circulating water systems depends primarily on the basic type of system, the total height through which the water must be lifted and whether the plant is a grade level or a basement type station. The extent of hydrographic and hydraulic studies in developing and delivering the water supply and with reference to main building substructure depends to a great extent on whether the station has a river or a lake source with direct circulation or any closed circulation system. The trend has been to use a pipe for the intake line, with the circulating water pumps in the crib house, as this combination tends to reduce costs in several ways. Illustrated examples of direct circulation river stations and closed circulation stations are given. (Upadhyaya-Vanderbilt)
W70-03548

USE OF RIVER MODELS IN COOLING CIRCULATING WATER STUDIES,
Worcester Polytechnic Inst., Mass.
For primary bibliographic entry see Field 05B.
W70-03549

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

THE MANAGEMENT AND CONTROL OF WATER IN PUERTO RICO,
Puerto Rico Univ., Mayaguez. Dept. of Agricultural Economics.
Isidoro A. Cordero.
Available from the Clearinghouse as PB-189 157, $3.00 in paper copy, $0.65 in microfiche. Water Resources Research Institute Technical Completion Report, Puerto Rico University, Sept 1969. 213 p, 14 tab, 49 ref. OWRR Proj No A-010-PR.

Descriptors: *Water resources development, *Puerto Rico, *Water management (Applied), Groundwater, Surface waters, Irrigation water, Water supply, Sewage treatment, Water pollution control, Flood control, Land management, Water sources, Evapotranspiration, Water law, Water rights.
Identifiers: Water resources management.

The present status of water resources management in Puerto Rico is reviewed. Topics discussed include the island's hydrology, streamflow, water availability, water use, water rights, predictions of future needs, water problems, and recommendations. The major problems are pollution control, reservoir sedimentation, flood control, irrigation needs, drainage, and salt water intrusion. Puerto Rico is rapidly industrializing and must solve these problems to continue increasing the standard of living. (Knapp-USGS)
W70-03246

FLOOD PLAIN INFORMATION, BLACK CREEK AND GENESEE RIVER IN THE TOWNS OF CHILI AND RIGA, MONROE COUNTY, NEW YORK.
Corps of Engineers, Buffalo, N.Y.

Report prepared for Genesee River Basin Regional Water Resources Planning Board. Corps of Engineers Flood Plain Report, Sept 1969. 48 p, 12 fig, 13 plate, 14 tab.

Descriptors: *Floods, *Flood damage, *New York, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Monroe County (NY), Standard project flood, Intermediate regional flood.

Flooding of Black Creek and Genesee River in Chili and Riga, Monroe County, New York is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-03261

FLOOD PLAIN INFORMATION, FLATHEAD, STILLWATER AND WHITEFISH RIVERS, KALISPELL - COLUMBIA FALLS, MONTANA.
Corps of Engineers, Seattle, Wash.

Report prepared for Montana State Water Resources Board. Corps of Engineers Flood Plain Report, Sept 1969. 57 p, 11 fig, 15 plate, 15 tab.

Descriptors: *Floods, *Flood damage, *Montana, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Kalispell (Mont), Columbia Falls (Mont), Flathead River, Standard project flood, Intermediate regional flood.

Flooding of the Flathead, Stillwater, and Whitefish Rivers, Kalispell - Columbia Falls, Montana is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-03272

FLOOD PLAIN INFORMATION, TIDAL AREAS OF PALM BEACH COUNTY, FLORIDA.
Corps of Engineers, Jacksonville, Fla.

Report prepared for Board of Commissioners of Palm Beach County. Corps of Engineers Flood Plain Report, Nov 1969. 36 p, 22 fig, 15 plate, 4 tab.

Descriptors: *Floods, *Flood damage, *Florida, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Storms, Tidal effects, Coastal plains, Hurricanes, Rain, Winds.
Identifiers: Palm Beach County (Fla), Standard project flood, Intermediate regional flood.

Flooding of the tidal areas of Palm Beach County, Florida is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the

construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-03273

PENN CENTRAL CO V BUCKLEY AND CO, INC (RAILROAD DENIED INJUNCTIVE RELIEF).

415 F2d 762-764 (3d Cir 1969).

Descriptors: *Navigable waters, *Railroads, *Bridges, *Boats, Admiralty, Legal aspects, Rivers, New Jersey, New York, Navigable rivers, Navigation, Transportation, Damages, Remedies, Judicial decisions.
Identifiers: Injunctions (Prohibitory).

The plaintiff, a railroad that owned and operated a draw bridge, was denied an injunction restraining certain tug boat operations. The court of appeals found that plaintiff had failed to show that monetary compensation would not provide adequate relief in the event of injury to the bridge or delays in rail traffic. The court considered navigation as the paramount use of the waterways; it treated bridge piers as tolerated obstructions. (Casey-Florida)
W70-03298

PIRMAN V FLORIDA STATE IMPROVEMENT COMM'N, AND STATE RD. DEP'T OF FLORIDA (BRIDGE CONSTRUCTION).

78 So2d 718-722 (Fla 1955).

Descriptors: *Bridge construction, *Florida, *Judicial decisions, *Riparian rights, Remedies, Riparian land, Bridges, Property values, State governments, Administrative agencies, Decision making, Economics, Project planning, Construction costs.

Certain property owners attacked the determination by an administrative agency of the location of a bridge to be constructed through a bay in connection with a road. They attempted to forestall construction of the bridge and brought suit contending that: (1) the legal description of the Palma Sola Bay Bridge was so indefinite that the actual location could not be determined and the determination of a lawfully constituted administrative authority was therefore arbitrary and capricious; (2) running the roadway through Palma Sola Bay violated the property rights of appellants owning riparian property on the Bay, north of the crossing. The suprmeme court, in affirming the lower court, held that there was no constitutional authority to the effect that the location of the bridge should be fixed with such certainty that it could be located by a surveyor, a prerequisite to issuance or validation of bonds. Nothing was evidenced to show that action by the board of county commissioners or any other lawfully constituted board was arbitrary and capricious. Therefore, the supreme court would not substitute its judgement for that of the boards in question. The riparian owners on the north shore of the Bay, who did not hold any property to be acquired in the building of the bridge were without right to compensation for violation of property rights. (Moulder-Florida)
W70-03300

LEVEE DISTRICTS.
Miss Const art 11, secs 227 thru 239 (1890).

Descriptors: *Mississippi, *Levees, *Water districts, *Administrative agencies, Boundaries (Property), Taxes, Tax rate, Assessments, Legislation, Mississippi River, Maintenance, Right-of-way, Construction, State governments, Legal aspects, Water policy, Zoning, Repairing, Administration, Management, Federal government, Supervisory control (Power).
Identifiers: *Alluvial land, Levee districts.

The Yazoo-Mississippi Delta Levee District and the Mississippi Levee District encompass and divide the alluvial land of the state for levee system purposes. Each district has a board of levee commissioners, and provision for their membership, qualifications, election, and bonding is detailed. Such commissioners shall have the power: (1) to supervise the erection, repair, and maintenance of levees in their respective districts; (2) to cede their rights of way and levees to the United States; and (3) to appropriate private property. No bills changing the boundaries of the district, or affecting the taxation or revenue of the district may be considered without proper publication. Each levee board makes an annual report to the Governor. The legislature shall: (1) levy a uniform tax upon lands in each levee district; (2) authorize the levee boards to fix the annual rate of taxation; (3) have the full power to provide a system of taxation for said levee districts; and (4) require the levee boards to publish an itemized account of their receipts and appropriations. No property between the levee and the Mississippi River shall be taxed for levee purposes. (Schram-Florida)
W70-03302

WALLACE V SCHNEIDER (SURFACE DRAINAGE).

219 SW2d 977-982 (Ky Ct App 1949).

Descriptors: *Kentucky, *Drainage water, *Diversion, Judicial decisions, Drainage systems, Surface runoff, Drainage, Drains, Channels, Culverts, Ditches, Sewers, Surface drainage, Riddance (Legal aspects), Surface waters, Drainage effects, Damages, Alteration of flow, Legal aspects.
Identifiers: Injunctions (Prohibitory).

An adjoining landowner constructed a system of drains, culverts, ditches, and gutters. Appellants alleged that this construction caused water to be discharged in unnatural quantities and at unnatural places on their land and to their damage. The lower court refused to grant an injunction to enjoin appellees from maintaining the aforementioned ditches, culverts, and drains. An appeal was taken. The lower court's decision was affirmed. The court held that the owner of the dominant estate may drain and ditch his land to rid it of surface water by construction of sewers, drains, and culverts without liability to the owner of the servient estate for damage, even though the flow of surface water onto the servient estate is thereby accelerated, so long as he does not: (1) tap additional watersheds or; (2) divert surface water from natural drains in which ditches, gutters, sewers, or culverts are constructed. The evidence presented sustained a finding that provisions (1) and (2) had not been violated. (Moulder-Florida)
W70-03321

PATY V TOWN OF PALM BEACH (GROIN-ORIGINATING LAND DAMAGE).

29 So2d 363-364 (Fla 1947).

Descriptors: *Florida, *Judicial decisions, *Breakwaters, Sea walls, Check structures, Jetties, Ocean waves, Shore protection, Barriers, Retaining walls, Coastal structures, State jurisdiction, Scour, Washouts, Wave pile-up, Damages, Cities.

The city of West Palm Beach had been authorized to construct seawalls, bulkheads, and groins to protect against destruction by the ocean. The implimentation of the foregoing authorization resulted in the alleged damage of plaintiff's land. Damage, to be actionable, must be coupled with negligence or misconduct. No action for damages arises from conduct of people in the execution of a public trust for the public benefit when such conduct reflects due skill and caution and is within the scope of authority. Here, the city was being sued for the alleged damages resulting from an authorized act. The resulting damage was damage without injury, hence the land owners could not recover from city. (Moulder-Florida)
W70-03330

NAVIGABLE WATERS.
Miss Code Ann sec 686 (1956).

Descriptors: *Mississippi, *Navigable waters, *Navigable rivers, *Bayous, Streams, Legislation, Rivers, Width, Dimensions, Depth, Distance, Length.

All rivers, creeks and bayous, twenty-five miles in length and having sufficient depth and width of water for thirty consecutive days in the year to float a streamboat with a capacity of two hundred bales of cotton, are navigable waters and public highways. (Schram-Florida)
W70-03337

LINCOLN'S EXPERIENCE IN REGULATING FLOOD PLAIN DEVELOPMENT,
Lincoln City-Lancaster County Planning Commission, Nebr.
For primary bibliographic entry see Field 06F.
W70-03341

THE ROLE OF OPEN SPACES IN FLOOD PLAIN MANAGEMENT,
Commissioner of Parks and Public Property, Cedar Rapids, Iowa.
For primary bibliographic entry see Field 06F.
W70-03342

DRAINAGE.

Ill Ann Stat ch 42, secs 10-1 thru 10-11 (Smith-Hurd 1956), as amended, (Supp 1969).

Descriptors: *Illinois, *Administration, *Water management (Applied), *Drainage districts, Legislation, Regulation, Drainage, State governments, Drainage systems, Drains, Levees, Administrative agencies, Economics, Legal aspects, Local governments.

When a petition praying for the abandonment of construction in a drainage district is filed with the court before a contract for such construction is entered, the court shall order the district commissioners to abandon such work. Similar procedures are available to cause abandonment of a portion of the proposed work. The procedure for abandonment in districts, subdistricts, and minor subdistricts is the same. The court may, upon petition by land owners, dissolve a drainage district. Provisions for such dissolution are set forth. If an order is entered by the court dissolving a district, the commissioners of the district become trustees vested with title to all real and personal property of the district. This property may be sold. Subdistricts and minor subdistricts, upon petition of land owners, may be dissolved in the same manner as provided for main districts. Whenever a district, subdistrict, or minor subdistrict has been dissolved, all drains and levees are deemed to be for the mutual benefit of the lands formerly in the district. (Moulder-Florida)
W70-03347

TILE CLOGGING BY IRON AND MANGANESE IN IMPERIAL VALLEY, CALIFORNIA,
Agricultural Research Service, Brawley, Calif.
Luther B. Grass.
J Soil Water Conserv, Vol 24, No 4, p 135-138, July-Aug 1969. 4 p, 7 fig, 2 tab, 19 ref.

Descriptors: *Drain tiles, *Tile drains, *Iron oxides, Manganese compounds, Drainage, Drainage engineering, Drainage systems, Tiles, Tile drainage, Drains, Deposition, Chemical precipitation, Soil types, Operation and maintenance, Irrigation operation and maintenance, Bibliographics, Iron bacteria.
Identifiers: *Clogging, Imperial Valley (Calif), Imperial Irrigation District (Calif).

Tile drains are used extensively in the Imperial Valley of California to control water tables and prevent salt accumulation in soils. By 1955, water tables had developed over some tile lines, reducing

crop growth either by restricting root growth or by increasing salinity. When opened for inspection, the lines were found clogged by black and red deposits composed of manganese and iron oxides. Theories proposed to explain the deposits are: (1) the problem predominates near faults, (2) the problem is peculiar to certain soil textures, and (3) the type of tile used contributes to the problem. A survey was made of tile lines in the Imperial Valley. The severity of clogging varied widely and the deposits were observed in various physical forms. The survey indicated that formation of red or black deposits was not related to location, soil type, kind of tile material, or length of time the drains had been in service. Tile systems clogged with iron and manganese deposits can be reclaimed effectively by treatment with sulfur dioxide gas and water. (USBR)
W70-03357

PUBLIC RIGHTS TO USE AND HAVE ACCESS TO NAVIGABLE WATERS,
For primary bibliographic entry see Field 06E.
W70-03380

ARE WE LOSING OUR LAKES,
For primary bibliographic entry see Field 06E.
W70-03382

OWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA,
For primary bibliographic entry see Field 06E.
W70-03386

CONSERVANCY DISTRICTS (WATERCOURSES, WATER RIGHTS AND USES, AND CONSTRUCTION AND MAINTENANCE OF RECREATIONAL FACILITIES).

Ohio Rev Code Ann secs 6101.20 thru 6101.25 (Page 1953), as amended, (Supp 1970), sec 6101.241 (Supp 1970).

Descriptors: *Ohio, *Administrative agencies, *Water utilization, *Water conservation, Bridges, Structures, Aqueducts, Streams, Sewers, Pipelines, Streamflow, Rainfall, Excavation, Channels, Flood control, Domestic water, Federal government, Drainage, Recreation, Soil erosion, Parks, Water supply, Riparian rights, Industrial water, Irrigation, Fisheries.

The court may order owners of bridges or structures over watercourses to remove or modify such structures pursuant to a district plan. If such changes are not made, the Board of Directors of Conservancy Districts can make them. The Directors have the power to improve watercourses. Private owners shall bear the cost of improvements required because of interference with water flow. Owners of bridges or grades shall provide access for dredge boats or other equipment. The Directors may make surveys and investigations of rainfall and stream flow and may provide for flood warning services. The Directors may enter into contracts with the United States Government or other public or private agencies for the development and maintenance of waters, parks, and recreational facilities. The rights of water users to the waters of the District shall remain the same, but the District will become the owner of improvements which it constructs. If the District is a riparian owner it has riparian rights. The District shall be compensated for the use of its waters. The Directors may construct and maintain recreational facilities. (Duss-Florida)
W70-03395

COUNTY WATER SUPPLY SYSTEMS.
Ohio Rev Code Ann secs 6103.01-6103.05 (Page 1953), as amended, (Supp 1970), secs 6103.051, 6103.052 (Supp 1970).

Descriptors: *Ohio, *Water supply, *Permits, *Administrative agencies, Legislation, State governments, Local governments, Water works, Water distribution (Applied), Equipment, Financing, Water conveyance, Sanitary engineering, Sewers, Water sources, Consumptive use, Water utilization, Legal aspects.

Public water supply is defined as wells, streams, and other sources, and the equipment necessary for the distribution of the water supply. The board of county commissioners of any county may acquire and operate any water supply within its boundaries. The board shall issue and enforce rules and rates regarding such supply. Permission for any construction regarding the supply must first be granted by the board. The board's authority for the supply located within a municipal corporation shall extend to main works only. The municipal corporation's legislative body may expand the board's authority. The board will retain jurisdiction over sewer districts annexed to a municipal corporation for water works purposes until all plans or improvements in progress are completed or abandoned. The county sanitary engineer shall submit a general plan for water supply to the board for approval. All assessments for water supplied may be deferred for good cause by the board. An advance of money from the water and sewer rotary fund can be made to cover the amounts not collected because of deferred assessments; advances by the fund are limited to the cost of authorized improvements. Repayment procedures are outlined. (Barnett-Florida)
W70-03396

WATER SUPPLY, SANITATION, AND DITCHES (COUNTY WATER SUPPLY SYSTEMS).
For primary bibliographic entry see Field 03D.
W70-03397

WATER SUPPLY--SANITATION--DITCHES (DEVELOPMENT OF WATER RESOURCES BY COUNTY COMMISSIONERS).
Ohio Rev Code Ann secs 6131.01 thru 6131.13 (Page 1953), as amended, (Supp 1970).

Descriptors: *Ohio, *Water conservation, *Water management (Applied), *Water resources development, Legislation, Legal aspects, Benefits, Ditches, Drains, Watercourses (Legal), Rivers, Levees, Embankments, Dams, Reservoirs, Streams, Lakes, Bridges, Flood control, Water utilization, Administrative agencies, Construction, Water resources, Surplus water, Financing, Estimated costs, Water policy, Regulation, Federal government, Cost-benefit theory.
Identifiers: *Improvements.

Improvement means the construction or beneficial alteration of any ditch, drain, watercourse, levee, wall, embankment, dam, or reservoir. Benefits means advantages resulting from drainage, conservation, control, and management of water. Benefits include the following: (1) elimination or reduction of flood damage; (2) removal of water conditions that jeopardize public health, safety or welfare; (3) resulting increased land values; (4) use of water for irrigation, storage, regulation of stream flow, soil conservation or water supply; and (5) providing an outlet for accelerated upland runoff. Boards of county commissioners may authorize improvements if they find that the improvement will be conducive to the public welfare and that the cost of the improvement will be less than the benefits conferred by its construction. Landowners and government agencies may petition boards to authorize improvements. The procedure to be followed in filing and amending petitions, posting bond for the cost of determining feasibility of the proposed improvement, viewing the site of the proposed improvement, preparation of preliminary cost estimates and conducting a hearing on the propsed improvement is in each case set forth. Boards may construct a complete or coordinating system of water conservation and flood control. (Keith-Florida)
W70-03401

WATER SUPPLY - SANITATION - DITCHES (DRAINAGE IMPROVEMENTS).

Ohio Rev Code Ann secs 6131.14, 6131.47, 6131.59, 6131.63, 6131.64 (Page 1953), as amended, (Supp 1970), 6131.631 (Supp 1970)

Descriptors: *Ohio, *Surface drainage, *Ditches, *Drains, Legislation, Legal aspects, Administrative agencies, Surveys, Planning, Structures, Estimates costs, Construction, Assessments, Boundaries (Property), Drainage, Natural resources, Easements, Culverts, Bridges, Contracts, Floodgates, Watercourses (Legal), Damages, Channels, Maintenance, Highways, Public utilities, Drainage engineering.
Identifiers: *Improvements.

The board of county commissioners will send a copy of its findings in favor of drainage improvements to the county engineer. The engineer will make a survey of and plans for the proposed improvement. The engineer will send such plans, along with cost estimates, to named administrative agencies for their approval. Upon receipt of approval, the engineer will forward the approved plans and cost estimates to the board. The engineer may direct the owner of any culvert, bridge, fence or floodgate to remove or alter the same when necessary for the construction of an improvement. The owner will be compensated for damages. When an improvement consisting of a ditch, drain or watercourse has been used as the outlet of agricultural drainage for seven years or more, it will be deemed to be a public watercourse. The public will have the same rights therein as it would in a natural watercourse. Owners of adjacent lands may agree to construct a mutually beneficial ditch or drain. When such agreement is filed with the county auditor, the ditch or drain is established as a public watercourse. If the board declares an improvement vacated, private rights in the improvement will not be affected. (Keith-Florida)
W70-03402

WATER SUPPLY - SANITATION - DITCHES (INTERSTATE COUNTY DITCHES).

Ohio Rev Code Ann secs 6135.01 thru 6135.27 (Page 1953), as amended, (Supp 1970).

Descriptors: *Ditches, *Interstate, *Ohio, *Drainage systems, Cooperatives, Drains, Drainage, Conduits, Distribution systems, Diversion structures, Drainage engineering, Statutes, Legislation, Local governments, Cost analysis, Costs, Projects, Project benefits, Engineers estimates, Project feasibility, Cost allocation, Outlets.
Identifiers: *Interstate county ditches.

A joint board to supervise interstate county ditch projects shall be composed of the boards of county commissions of counties affected in Ohio and those boards affected in adjoining states. The procedure, powers, and duties of the joint board at the organizational meeting are established. The duties of the engineer appointed by the joint board are enumerated. Specific regulations set forth the rules governing subsequent joint board meetings. The power to enter upon lands in Ohio in connection with interstate county ditch projects is delegated to the proper authorities in the adjoining state. Project costs are apportioned and lands not mentioned in the first engineer report may be assessed. Ohio boards of county commissioners are permitted to conduct work beyond the state limits if authorized by the adjoining state. Procedures concerning claims for compensation and damages are provided. Water outlet projects located in either Ohio or an adjoining state are regulated. The methods of financing or assessing the costs of such projects are prescribed. The boards of county commissioners in Ohio must record in their journals the details of all interstate county ditch agreements. Absent specific interstate county ditch provisions, the laws governing Ohio county ditches control. (Powell-Florida)
W70-03403

WATER SUPPLY--SANITATION--DITCHES.

Ohio Rev Code Ann secs 6139.01 thru 6139.06 (Page 1953).

Descriptors: *Ohio, *Ditches, *Drains, *Drainage systems, Subsurface drains, Drainage, Conduits, Distribution, Systems, Diversion structures, Drainage engineering, Controlled drainage, Subsurface drainage, Surface drainage, Legislation, Local governments, Cost analysis, Projects, Project benefits, Cost allocation, Outlets.
Identifiers: *Township ditches.

A petition to improve a ditch or drain located within a township and having an outlet in a public watercourse may be filed with the clerk of such township. The work and material for construction of an improvement are apportioned among the landowners according to the benefits received. If the owner does not construct his portion of the improvement, the cost of such township ditch improvement will be assessed to the landowner. The rights and remedies afforded to a landowner affected by an improvement are provided in sections 6131.01 to 6131.64, inclusive of the Revised Code. The jurisdiction of the boards of county commissioners and boards of township trustees in regard to location of ditches is provided. The procedures to be followed for locating underground drains on land adjoining upland owners and for compensating the lower landowner are regulated. (Powell-Florida)
W70-03404

CONSERVATION OF NATURAL RESOURCES (WATER IMPROVEMENTS).

Ohio Rev Code Ann secs 1523.01 thru 1523.20 (Page 1964), as amended, (Supp 1970).

Descriptors: *Ohio, *Flood control, *Water conservation, *Navigation, Legislation, Dams, Legal aspects, Canals, Administrative agencies, Surplus water, Public health, Safety, Reservoirs, Dikes, Planning, Financing, Contract administration, Contracts, Hydroelectric power, Jurisdiction, Bridges, Culverts, Surveys, Construction, Maintenance, Riparian rights, Water supply, Estimated costs.
Identifiers: *Water improvements, Storage basins, Emergencies, Slack-water dams.

The Chief of the Division of Water is authorized to construct such reservoirs, dams, storage basins, dikes, canals, raceways and other improvements as are necessary for the following purposes: (1) to insure and promote the public health, welfare and safety; (2) to encourage and promote agriculture, commerce, manufacturing and other public purposes; and (3) to preserve the use of waters required for navigation. The Chief may also make additions to, enlarge, and alter existing improvements for such purposes. Before the Chief begins any such construction, he will submit plans and cost estimates of the proposed improvement to the Governor for approval. The procedure to be followed by the Chief in issuing bonds to finance improvements is delineated. The procedure to be followed by the Chief in the letting and administering of contracts for the construction or maintenance of improvements is set forth. The Chief may sell or lease water and power from future and existing improvements unless to do so would be detrimental to canal navigation. Bonds issued on improvements constitute a lien which may be foreclosed. No reduction in the quantity or quality of the water supply of any city is authorized by this chapter. (Keith-Florida)
W70-03406

STATE'S POWER OVER WATERS OF LAKE ERIE AND OVER LEASING OF LAKEFRONT LAND FOR PRIVATE IMPROVEMENT.
For primary bibliographic entry see Field 06E.
W70-03410

COMPACT CONCERNING PYMATUNING LAKE.
For primary bibliographic entry see Field 06E.
W70-03411

WATERS, WATERWAYS, DRAINS AND LEVEES (WATERCOURSES).

Tenn Code Ann secs 70-101 thru 70-121 (1956).

Descriptors: *Tennessee, *Navigable waters, *Water resources development, *Navigation, Navigable rivers, Riparian rights, Riparian waters, Ships, Boats, Transportation, Sluices, Sluice gates, Regulation, Channels, Diversion structures, Highways, Administration, Administrative agencies, Railroads, Bridges, Fish, Fish barriers, Fish migration, Stream improvement, Mill dams, Mills, Legislation, Legal aspects.

All navigable waters are public highways. The quarterly county court may contract to open or clean out any navigable stream within the county. Overseers may be appointed for such navigable stream districts as the county may lay off, and regulations therein shall be the same as in the case of public roads. Court appointed supervisors of water improvements shall investigate and prosecute all offenses committed in regard to streams. It is unlawful to divert water from or to obstruct the navigation of the main or natural channel of any navigable watercourse. The water of any sluice may be diverted into a main channel for the immediate passage of a boat but must be returned so as not to impair the profit of the mill. The county court may permit and/or remove local improvements and erections in watercourses provided navigation is not interrupted. The court may appoint commissioners to see that local erections conform to law and allow the free passage of fish. Railroad companies shall operate drawbridges according to set standards. All eleemosynary institutions shall have the right to obtain property for the purpose of procuring water. (Smith-Florida)
W70-03413

LEVEE AND DRAINAGE DISTRICTS.
Tenn Code Ann secs 70-901 thru 70-914 (1956), as amended, (Supp 1969).

Descriptors: *Tennessee, *Drainage districts, *Financing, *Assessments, Levees, Flood control, Flood protection, Legislation, Administrative agencies, Construction, Construction costs, Drainage engineering, Drainage programs, Drainage systems, Taxes, Payment, Tax rate, Costs, Cost-benefit ratio, Cost-benefit theory, Benefits, Evaluation.

When a levee or drainage district is established, the county court shall appoint three uninterested commissioners from the county, one of whom shall be an engineer. The commissioners shall assess all lands benefited by the levee or drainage district by the amount of benefit and equitably apportion the expenses, construction costs, and damages for such improvement. All of the above information, as well as the description and ownership of the land, shall be reported to the county court. Any railroad or public highway will be assessed for any benefit received from the levee or drainage district's improvements. (Schram-Florida)
W70-03416

ESTABLISHMENT OF DRAINAGE DISTRICTS BY MUTUAL CONSENT.
Tenn Code Ann secs 70-1701 thru 70-1703 (1956).

Descriptors: *Tennessee, *Drainage districts, *Ditches, *Drains, Legislation, Jurisdiction, Drainage systems, Construction, Locating, Sites, Damages, Assessments, Benefits, Judicial decisions, Watercourses (Legal), Drainage programs.

The owners of land which require combined drainage may provide for the establishment of a drainage district or the location and construction of drains, ditches, and watercourses upon their own lands. Such an agreement may specify the location, the character of work to be done, the adjustment of damages, the classification of lands to be benefited, the amount of special assessments, and the time for levying assessments. Upon filing the agreement with the clerk of the county court, the court shall establish such drainage district and locate the ditch, drain, or watercourse as provided in the agreement. The court shall have complete jurisdiction over the parties and the subject matter. (Schram-Florida)
W70-03419

TENNESSEE-TOMBIGBEE WATERWAY DEVELOPMENT COMPACT.
For primary bibliographic entry see Field 06B.
W70-03422

WATER RESERVOIR SYSTEMS.
Autonetics Division of North American Rockwell Corporation, Anaheim, California, Life Sciences Operations.

Available from the Clearinghouse, Vol 1, PB-189 340, Vol 2 as PB-189 341, $3.00 each in paper copy, $0.65 each in microfiche. Final Report of North American Rockwell Corporation to Office of Water Resources Research, Department of Interior, 2 Vol: Vol 2, Nov 1, 1968. 184 p, 53 fig, 35 tab, 26 ref, 1 append Vol 2, Dec 22, 1969. 73 p, 17 fig, 13 tab, 24 ref. OWRR No C-1187 (1595).

Descriptors: *Flood control, *Cities, *Urbanization, *Reservoirs, Costs, Cost-benefit analysis, Drainage systems, Economics, Social aspects, Dams, Multiple-purpose projects.
Identifiers: *Urban flood-control reservoirs.

Water reservoir systems were investigated for urban areas as an alternative or complement to storm water drainage systems for flood control which could provide benefits in water conservation and reduce drainage system costs. Santa Maria, California, was selected as a study site. Santa Maria has characteristics of seasonal rainfall that cause urban flooding, a need for water conservation (dropping water table), and high underground water percolation rates that favor a reservoir system. The study included a total of 8,000 acres of which 2,500 acres are highly urbanized, 3,800 acres represent future urban development and 1,700 acres are projected as agricultural through the year 2000. The Stanford Watershed Model was used for a computer simulation of the Santa Maria watershed and design of the reservoir system. The reservoir system cost for the total Santa Maria area of 8,000 acres is $7.0 million, a significant decrease in cost over the conventional system even with the addition of land costs. Water conservation and multiple land use benefits provide distinct economic advantages in favor of the reservoir system that can defray up to 50% of the system costs. (Knapp-USGS)
W70-03435

GRACI V UNITED STATES (FEDERAL GOVERNMENT'S LIABILITY FOR NEGLIGENCE IN CONSTRUCTION OF NAVIGATION AID PROJECT).

301 F Supp 947-956 (ED La 1969).

Descriptors: *United States, *Flood control, *Flood damage, Judicial decisions, Legal aspects, Mississippi River, Rivers, Louisiana, Navigation, Navigable waters, Floods, Projects, Bodies of water, Damages, Flood protection, Jurisdiction, Water injuries, Remedies.
Identifiers: Flood Control Act, Federal Tort Claims Act.

The defendant United States moved for dismissal of a tort claim by plaintiff homeowners for flood water damage allegedly caused by defendant's

negligence in the construction of navigation aid projects. The court rejected the government's contention that the actions were not maintainable by virtue of the immunity clause contained within the Flood Control Act, and held that the federal government could be held liable if negligence was proven. The court relied upon the Federal Tort Claims Act's more reasonable, liberal, and equitable policy of a general waiver of immunity in the particular circumstances of this action notwithstanding the Flood Control Act, which eliminates federal liability for flood damages. The court permitted plaintiffs to litigate their claim for damages, but placed them under a burden of proof greater than in a normal tort case. (Casey-Florida)
W70-03444

STOCHASTIC DESCRIPTION OF DAILY RIVER FLOWS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-03497

RELIABILITY ESTIMATES FOR A STORAGE RESERVOIR WITH SEASONAL INPUT,
Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
Vit Klemes.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 54, p 414-421, 1967. 8 p, 1 fig, 4 ref.

Descriptors: *Streamflow forecasting, *Reservoir operation, *Reservoir yield, *Probability, *Statistical methods, Safe yield, Runoff forecasting, Water storage.
Identifiers: Reservoir content probability.

Reliability of storage-reservoir operation may be judged from three different points of view. One may consider the number of failures in water supply within a given period, or the total duration of failures, or the deficit of water not supplied to the consumer. According to the criterion adopted, three different characteristics of reliability can be used, in particular, the occurrence-, time-, and quantity-based 'certainty'. While certainty is represented by a single value if an unlimited period of time is considered, it has a distribution in case of finite period. A method is presented for determining the distribution of certainty of any of the three above mentioned types, for a reservoir with seasonal input. The method employs Moran's discrete approximation to a continuous distribution, and Gould's method for determination of the transition probabilities. (Knapp-USGS)
W70-03498

STATE WATER POLICY COMMISSION - POWERS AND DUTIES.

N J Stat Ann secs 58: 1-9 to 58: 1-13, 58: 1-15 to 58: 1-18, 58: 1-24 (1966).

Descriptors: *New Jersey, *Administrative agencies, *Water resources development, *Legislation, Legal aspects, Water supply, Diversion, Condemnation, Project planning, Water sources, Investigations, Dams, Irrigation, Watershed management.
Identifiers: Reports.

The State Water Policy Commission shall have all the powers and duties formerly vested in the Department of Conservation relating to water supply matters, control of dams, flood control, irrigation and water power. The commission shall supervise all public water supplies. The Commission shall complete a study of the water resources of the entire state to allow it to perform its assigned duties. The findings of such study shall be reported to the legislature to the end that a final plan will be formulated for the economical and comprehensive development of the watersheds of this state. Plans for watershed development must provide sufficient details of the developments to be made to allow coordination of such plans. The Commission may require annual reports relative to water diverted for water supply purposes. A quarterly report of the amount of water used by waterworks is also required. The Commission must approve any condemnation of new or additional sources of water supply for projects to supply inhabitants with water. Plans for such projects must be submitted to the Commission for approval. Before such Commission approved water supply systems can begin operation, the work itself must be approved by the Commission. (Sisserson-Florida)
W70-03499

STATE WATER POLICY COMMISSION - POWERS AND DUTIES.

NJ Stat Ann secs 58:1-25, 58:1-26, 58:1-31, 58:1-33, 58:1-35, thru 58:1-38, 58:1-45 (1966).

Descriptors: *New Jersey, *Administrative agencies, *Water supply, *Water resources development, Legal aspects, Watershed management, State governments, Legislation, Diversion, Investigations, Dams, Permits, Consumptive use, Streams, Construction, Impounded waters, Channel flow, Public rights, Diversion structures.

The state Water Policy Commission may order the interconnecting of public water supply systems and require the furnishing of water by means of any such system to another. The Commission shall regulate the construction, maintenance, and removal of structures within streams to preserve the channels of streams and to safeguard the public against danger from waters impounded by such structures. The Commission may enter on any land or water for any investigation authorized by this chapter. This chapter does not limit the powers of existing water works systems to develop their present system. However, approval must be obtained from the Commission for constructing or enlarging dams. The definitional section defines such terms as consumptive use, surface waters and low flow. The Water Policy and Supply Council in the Department of Conservation shall delineate those watershed areas in need of regulation. In such areas a permit shall be required to divert water for other than domestic use at a rate greater than 70 gallons per minute. Such permit shall be issued without a public hearing when satisfactory evidence is provided that the water diverted is not to be consumptively used. Nothing in this chapter shall affect the storage and regulation of the discharge of stored waters to supplement streams. (Sisserson-Florida)
W70-03514

VACATION OR RELOCATION OF WATERCOURSES - CONSTRUCTION OF DAMS.
Pa Stat Ann tit 53, secs 2801-2802, 2815, 2831 (1957).

Descriptors: *Pennsylvania, *Dams, *Channel improvement, *Cities, Channels, Relocation, Legislation, Condemnation, Eminent domain, Watercourses (Legal), Navigable streams, Public health, Local governments, Alteration of flow, Water works, Water supply, Dam construction, Sanitary engineering, Compensation, Condemnation value, Stream improvement, Domestic water, Channeling, Legal aspects.

Any city may by ordinance vacate, alter, or relocate the course or channel of any creek, run or natural waterway, other than navigable streams, when it deems it essential to the preservation of the health and welfare of its inhabitants. The city may enter upon, condemn, and take any property within the city's limits as may be necessary to effect such change. If any such creek, run, or natural waterway is used by and municipality or water company as a source of supply of water, the municipality or water company must first consent to the proposed relocation. Whenever the state allows a city to construct and maintain a dam in a public navigable river flowing through the city to improve the sanitary conditions of the city, power is also granted to purchase, acquire, and appropriate private property for that purpose. If the city cannot agree with the owners of the private property upon the compensation for the appropriated property, any interested party may petition the county court to appoint viewers to ascertain the damages done by such taking. (Schram-Florida)
W70-03521

FLOOD CONTROL.
Pa Stat Ann tit 53, secs 2866 (1957), 2862 (Supp 1969).

Descriptors: *Pennsylvania, *Flood control, *Flood protection, *Assessments, Cities, Legislation, Channel improvement, Dikes, Flood damage, Floods, Streams, Local governments, Construction, Banks, Channels, Bank protection, Stream improvement, Rivers, Public benefits, Floodwater, Taxes, Costs, Cost allocation, Cost-benefit analysis, Benefits, Financing, Legal aspects.

Any municipality may erect or construct dikes, river bank protection, and other flood control works and widen, deepen, straighten or otherwise improve the channels and banks of creeks, streams, and rivers. These improvements may be made either within or without the county in which the municipality is situated. Any two or more municipalities may jointly construct these improvements and may enter into agreements with other public authorities as may be necessary for such purposes. Any municipality may provide for the assessment of benefits against private property located within its corporate limits. No assessment shall be made against private property unless, in the opinion of the board of viewers making the assessment, the property will be benefited by the prevention or lessening of future flood damage. The fact that private property has been damaged by flood from the waters of the stream on which the work is being done shall be conclusive evidence that benefit will accrue to such property. No exemption shall exist because the property does not abut on any improvement or on the stream carrying the flood waters. (Schram-Florida)
W70-03529

BRIDGES AND VIADUCTS.
Pa Stat Ann tit 53, secs 2501, 2504, 2551, 2581, 2611, 2619, 2628 (1957).

Descriptors: *Pennsylvania, *Bridges, *Bridge construction, *Cities, Legislation, Local governments, Structures, Abutments, Piers, Railroads, Rivers, Streams, Highways, Construction, Maintenance, Landfills, Slopes, Condemnation, Costs, Erection, Transportation.

The cities of the Commonwealth may locate and build viaducts or bridges over rivers, streams, railroads, and private property for the purpose of uniting two or more highways. These constructions may be partially within and partially outside of the city limits. The cities may contract with the proper county commissioners, railroad interests, or any other interested parties for the construction, maintenance, or damages, caused by such bridges or viaducts. The cities may enter upon, take, and use private property to construct bridges over streams which separate any portions of such cities. Any city may also acquire any existing bridges that cross streams which divide the city. The municipalities of the state may purchase, condemn, or maintain any public toll bridge crossing any river or stream within the limits of such municipalities. Said cities may contract with county commissioners for the county to pay a portion of the costs of the toll bridges. It is unlawful to erect any free bridges over the Juanita River within one mile of any toll bridge constructed by a Pennsylvania corporation. If a county, however, wishes to purchase a toll bridge to make it a free bridge, it may do so under certain provisions. (Schram-Florida)
W70-03533

OBSTRUCTIONS IN NON-NAVIGABLE WATERS.
Wis Stat Ann sec 60.68 (1957).

Descriptors: *Wisconsin, *Non-navigable waters, *Obstruction to flow, *Streams, Creeks, Legislation, Cities, Navigable waters, Natural flow doctrine, Barriers, Navigation, Riparian rights, Streamflow, Flow, Legal aspects.

Whenever any non-navigable stream becomes obstructed so that the natural flow of water is prevented, the supervisors of the town in which the obstruction is located may, at the expense of the town, remove the obstruction. The supervisors are authorized to enter upon any lands necessary to carry out such purpose. (Casey-Florida)
W70-03536

HIGHWAY TO ISLANDS IN MISSISSIPPI RIVER.
Wis Stat Ann sec 80.15 (1957).

Descriptors: *Wisconsin, *Mississippi River, *Islands, *Road construction, Legislation, Administrative agencies, Access routes, Transportation, Eminent domain, Condemnation, Easements, Right-of-way, Navigable waters, Legal aspects.

An owner of an island in the bottoms of the Mississippi River who is shut out from the bank of the Mississippi River and from a highway by other islands, sloughs, or the lands of others through which rights-of-way cannot be purchased at a reasonable price may present to the supervisors of the town an affidavit which sets out these facts and describes the land. The supervisors shall, in their discretion, give relief under 80.13 of this act which provides for the construction of a highway when a real estate owner is shut out from all public highways. The town shall not be liable for want of repair or for defects in any highway laid out pursuant to this section, nor for any accident or injury thereon. (Barnett-Florida)
W70-03538

GRIMES V POLK COUNTY (PUBLIC RIGHTS IN PRIVATE DRAINAGE SYSTEMS).
34 NW 2d 767-773 (Iowa 1949).

Descriptors: *Iowa, *Road construction, *Drainage systems, *Surface runoff, Flood damage, Local governments, Drainage, Drainage engineering, Drainage water, Drainage effects, Outlets, Water control, Water sources, Judicial decisions, Building codes, Damages, Paving, Right-of-way, Highways, Prescriptive rights, Eminent domain, Surface drainage, Surface waters, Legal aspects, Surplus water.

Plaintiff's equitable complaint stated that in grading and paving a highway, defendant, Polk County, had caused an unlawful diversion of and interference with a natural water course which resulted in an excessive and unusual amount of water being cast upon her land. Plaintiff claimed defendent violated a statute requiring highways to be properly drained before paving is laid. Plaintiff's land was the servient estate in a common drainage project, and the water flowing thereon was from the dominant estate. A dominant estate has a right to discharge surface waters upon a servient estate. The court held that due to a lapse of over twenty years defendant has acquired prescriptive rights to the drainage project drains. Plaintiff knew of these drains when she purchased the land. Defendant has a statutory right to connect with the drainage project and to dispose of surface water on public highways, through private ditches and onto plaintiff's land. Where a former dirt highway is paved without a substantial change in grade, no drainage district must be created. The court held that casting such additional water on plaintiff's land was not a taking without compensation. (Smith-Florida)
W70-03562

OPINION OF THE JUSTICES (WATER AND SEWER DISTRICT LEGISLATION).
253 A2d 309-338 (Me 1969).

Descriptors: *Maine, *Water districts, *Sewage districts, *Public utilities, Judicial decisions, Legislation, Sewers, Governments, Sewage, Wastes, Sewage disposal, Sewage treatment, Flow, Water supply, Water, Rivers, Streams, Ponds, Dams, Reservoirs, Pumping plants, Eminent domain, Condemnation, Water storage.

The Senate of Maine requested the Justices of the Supreme Judicial Court to give opinions on the constitutionality of five bills pending in the Senate. The Court held that constitutional limitations on encroachment upon home rule rights of local governments did not invalidate the bills. The bills generally authorized certain water and sewer districts and companies to begin or expand water and sewer services. The Portland Water District is authorized to transmit, treat and dispose of waste water and sewage. The Harrison Water District is authorized to collect, store, and convey water from any body of water whether on the surface or underground. The Harrison District is also authorized to construct and maintain pipes, dams, wells, reservoirs, pumping stations and other structures necessary to furnish water for public purposes. For these purposes the District may acquire any land or water rights by gift, purchase or condemnation. The jurisdiction and borrowing power of other districts are extended. (Smith-Florida)
W70-03564

DRAINAGE DISTRICTS (ANNEXATION AND DETACHMENT OF LANDS).
Ill Ann Stat ch 42, secs 8-1 thru 8-22 (Smith-Hurd 1956), as amended, (Supp 1969).

Descriptors: *Illinois, *Drainage systems, *Drainage districts, *Boundaries (Property), Legislation, Legal aspects, Drains, Ditches, Assessments, Judicial decisions, Cities, Levees, Storm drains, Outlets, Easements, Structures, Surface drainage, Multiple-purpose projects, Watersheds (Basins), Taxes, Financing, Cost allocation, Construction, Remedies.
Identifiers: Penalties (Civil).

Lands may be annexed to or detached from a drainage district. An owner of land lying outside a district but within the district's natural drainage area may connect his land to any ditch or drain of the district. By making such a connection, a landowner gives implied consent to the annexation of his land to the district. When land outside of a district has been connected to a district drain or when it will be benefited by any district work, the district commissioners may petition the court to annex such land to the district. Owners of land outside a district but within its drainage area may petition for annexation. Notice and hearing requirements concerning petitions are set forth. Land annexed to a district will be subject to assessments for improvements. Owners of land within a district may petition for detachment if their land is not and cannot presently be benefited by any work of the district. The court may detach land from one district and annex it to another. Land located within the boundaries of a drainage district and within the corporate limits of a city may be detached from the district, provided the city agrees to pay the district assessments for the continued drainage benefit to the land. (Keith-Florida)
W70-03565

DRAINAGE DISTRICTS.

Ark Stat Ann secs 21-501 thru 21-586 (1968).

Descriptors: *Arkansas, *Drainage districts, *Levees, *Administration, Benefits, Assessments, Taxes, Damages, Drains, Ditches, Financing, Condemnation, Federal government, Construction, Cost repayment, Administrative agencies, Legislation, Real property, Cost sharing, Maintenance, Erosion, Cost allocation, Cost-benefit theory, Construction costs.

The procedures for establishing a drainage district in Arkansas are detailed. Provision is made for the appointment of a board of commissioners to control each district, and their powers and duties are outlined. A detailed procedure for assessing all property in the drainage districts according to the benefit theory is included. The manner of implementing drainage improvements is detailed with provision for extending the benefits and assessments beyond the drainage district. The procedure for taxing property within the drainage district is discussed and provision made for collection and repayment, and remedies for delinquency and default. Details of financing district improvements are included. A procedure for abolishing unnecessary or impractical districts is set forth. This act shall serve as an alternative means of creating a drainage district; the act does not repeal prior laws. Provisions for maintenance of the drainage district are discussed. A plan of cooperation with the federal government in constructing and maintaining drainage improvements is detailed. Provisions for subdistricts and districts created under special acts of the state legislature are outlined. Penalties are provided for violations of certain sections of this act. (Schram-Florida)
W70-03566

DRAINAGE DISTRICTS (ESTABLISHMENT).
Ark Stat Ann secs 21-501 thru 21-517 (1968).

Descriptors: *Arkansas, *Drainage districts, *Assessments, *Benefits, Legislation, Drainage systems, Drains, Ditches, Damages, Administration, Administrative agencies, Compensation, Condemnation, Right-of-way, Condemnation value, Taxes, Drainage effects, Cost-benefit theory, Drainage programs, Drainage practices, Construction.

Creation of a drainage district may be sought by petition to the county court. Provisions are included for bonding a survey of the proposed site, appointing an engineer, paying expenses, and conducting a public hearing. The appointment of district commissioners and the organization of a drainage board are discussed. The formation of subdistricts is permitted upon petition of three landowners. The appointment procedure for commissioners of subdistricts is set forth. The commissioners are authorized to assess the costs of improvements against all lands, public and corporate roads, and railroads benefited by the drainage system. The commissioners are directed to assess and award damages for injuries to land which arise from project construction. If lands outside the district are benefited, the county court may, after notice and a hearing, extend the boundaries of the district to include these lands. Upon completion and filing of all assessments by the commissioners, notice is to be given and complaints and appeals may be made by affected landowners. If a landowner so requests, damages to his land may be recovered through condemnation proceedings. Procedures for altering the plans for improvements and for reassessing necessary property are detailed. (Schram-Florida)
W70-03567

DRAINAGE DISTRICTS (CONSTRUCTING IMPROVEMENTS).
Ark Stat Ann secs 21-518 thru 21-541 (1968).

Descriptors: *Arkansas, *Drainage districts, *Assessments, *Financing, Drains, Ditches, Legislation, Administration, Administrative agencies, Benefits, Cost-benefit theory, Drainage systems, Drainage programs, Bridges, Construction, Taxes, Tax rate, Sewers, Condemnation, Condemnation value, Width, Depth, Length, Levees, Drainage practices.

Commissioners may extend and improve the drains in their district and may issue bonds to finance

these improvements. Commissioners may make annual reassessments of benefits, provided adequate notice is given to affected landowners. Before assessments for further improvements may be confirmed, a majority of the landowners in the district must petition for the construction of those improvements. The procedures for filing petitions and provisions for notice, hearing, and appeal are detailed. The Commissioners will control the construction of these improvements. Provisions are made for taking bids, soliciting contractor's bonds, and purchasing materials. Landowners may build ditches to drain water from their lands into the public ditches. The ditches may cross the lands of intervening landowners. The district is directed to build bridges over its ditches where they intersect county highways. The Commissioners may regulate the manner of building bridges and fences across any ditch to prevent injury to the drainage system. The Commissioners may construct ditches beyond the district when necessary and may acquire rights-of-way necessary to this construction. The Commissioners may levy additional taxes, with court approval, to maintain the district's improvements. Provisions are made for assessing annexed lands, reassessments, and additional assessments for increased benefits. The district may be extended to include lands served by sanitary sewers connected to drainage ditches. (Schram-Florida)
W70-03568

DRAINAGE DISTRICTS (TAXATION).
Ark Stat Ann secs 21-542 thru 21-550 (1968).

Descriptors: *Arkansas, *Drainage districts, *Taxes, *Tax rate, Financing, Legislation, Cost-benefit theory, Cost-benefit ratio, Administration, Administrative agencies, Assessments, Payment, Construction, Evaluation, Real property, Administrative decisions, Cost repayment, Bids, Interest.

The county court may order a tax levied upon the drainage district to pay improvement costs. A tax so imposed is a lien on all real property in the district, and is assessed proportionately for benefits derived from the district. Procedures for appeal from assessments and for compelling the court to comply with this section are outlined. Provisions are set forth for collection of drainage district taxes. A time limit is set for the payment of taxes and remedies are provided against delinquent taxpayers. Procedures are outlined for the sale of property subject to the drainage district's lien. (Schram-Florida)
W70-03569

CONTROL AND IMPROVEMENT OF NATURAL WATERCOURSES.
Ohio Rev Code Ann sec 755.28 (Page 1953).

Descriptors: *Ohio, *Watercourses (Legal), *Administration, *Eminent domain, Legislation, Local governments, Cities, Sewers, Maintenance, Construction, Management, Natural streams, Developed waters, Water Control, Water rights, Easements, Condemnation, Land, Cleaning, Water circulation, Water conveyance, Administrative agencies, Legal aspects.

The board of park trustees supervises the work of straightening, cleaning, deepening, or otherwise improving any natural watercourse with the city, even if used for sewer purposes. The board may purchase, acquire, or condemn any water rights, easements, or privileges in connection with any natural watercourse within the city and may acquire or condemn necessary real estate. (Powell-Florida)
W70-03580

LEVEES.
Tenn Code Ann secs 70-601 thru 70-623 (1956).

Descriptors: *Tennessee, *Levees, *Financing, *Local governments, Construction costs, Construction, Capitol, Government finance, Interest, Principal, Overflow, Water levels, Flood damage, Administrative agencies, Taxes, Condemnation, Condemnation value, Cost repayment, Compensation, Judicial decisions.
Identifiers: *Bonds.

County courts may issue bonds for the construction of levees to protect potential overflow lands. These bonds must be approved by three-fourths of those voting in a regular election. A selected group of levee commissioners shall superintend the construction of the levee, contract for the work done, and draw bonds as needed, to pay for the construction. The county court shall levy a tax to pay the interest and the principal on the bonds. The commissioners may apply to the court for condemnation proceedings to obtain private land needed for the levees. The county court may then, following proper procedure, decree the land to the county, and a jury shall assess the compensation to be paid to the owner. Commissioners may recieve subscriptions of money or property for the use of the county. Where the value of property is enhanced by the construction of levees, the county may retain such increment of taxes realized from this increased valuation. Funds so realized by the county shall be used to discharge bond indebtedness. (Dearing-Florida)
W70-03581

DRAINAGE AND LEVEE DISTRICTS.

Tenn Code Ann secs 70-701 thru 70-734 (1956).

Descriptors: *Tennessee, *Drainage districts, *Drainage systems, *Levees, Engineering structures, Drainage programs, Drainage engineering, Drainage, Land management, Drainage water, Drains, Natural streams, Water resources development, Natural resources, Stream improvement, Channel improvement, Costs, Cost-benefit theory, Cost allocation, Assessments, Railroads, Expenditures, Surveys, Mapping, Legislation, Legal aspects.

The county court of any county may establish drainage districts, construct any levee, drain or watercourse, and straighten, widen or change any natural watercourse, provided a petition, signed by persons who own a majority of the acreage to be affected, is filed with the court. A preliminary expense fund shall be created by assessing all landowners named in the petition. A disinterested engineer, appointed by the court, shall examine the lands described in the petition and shall submit a report setting forth a plat and profile of the improvements proposed in the petition, together with probable costs and other recommendations he may deem material. Ditches and drains shall be located along the general course of natural watercourses unless there is some special reason to depart therefrom. When any ditch or drain crosses any railroad right-of-way it shall be located at the place of the natural waterway, unless the railroad has provided for or agreed to another place. After the engineer's report has been filed, the court may make a special assessment upon all lands within the proposed district for expenses already incurred. (Smith-Florida)
W70-03582

ESTABLISHMENT OF DRAINAGE AND LEVEE DISTRICTS.
Tenn Code Ann secs 70-801 thru 70-809 (1956).

Descriptors: *Tennessee, *Drainage districts, *Levees, *Damages, Legislation, Drains, Ditches, Watercourses, Channels, Right-of-way, Condemnation, Drainage, Public benefits, Public health, Natural streams, Beds, Ownership of beds, Depth, Width, Compensation, Condemnation value, Legal aspects, Assessments.

Any person claiming damages as compensation for the construction of any improvements of the drainage district must file a claim three days before the hearing for the establishment of such district. If any such claims have been filed, the county court shall not establish the district until the damages have been ascertained by the engineer and viewers appointed by the court. The viewers shall assess the damages that would be caused by establishing the district and report these to the court. Any incidental benefits to the landowner may be considered in estimating incidental damages, but the value of the land to be taken shall be given without deductions. The court shall consider the reported damages in deciding whether the levee or drainage district should be established. If the cost of construction is not too great a burden on the land to be benefited and the improvement is conducive to the public health, welfare or benefit, then the court shall establish the district. After the damages have been ascertained by the court, they shall be paid by the parties benefited by the district. In establishing any district, all necessary lands may be appropriated by condemnation and a right-of-way may be appropriated for any ditch, drain, or watercourse. The natural bed of such watercourse may also be appropriated. (Schram-Florida)
W70-03583

WATERS, DRAINS AND LEVEES (DRAINAGE DISTRICTS).
Tenn Code Ann secs 70-1301 thru 70-1340 (1956), as amended, (Supp 1969).

Descriptors: *Tennessee, *Administrative agencies, *Drainage districts, *Assessments, Legal aspects, Legislation, Adjudication procedure, Cost sharing, Appraisals, Drainage programs, Local governments, Cost allocation, Decision making, Project planning, Administrative costs, Maintenance costs, Taxes, Government finance.

The county court has the power to make a special assessment to pay costs and expenses made after creation of a drainage district. The collection and enforcement of such assessments are regulated. Procedures involving an appeal from an order of court fixing assessments are prescribed. The creation and operation of a special maintenance fund is regulated. Levied assessments are recorded by the county court clerk in the drainage assessment book. The vendee in a voluntary sale of property located within a drainage district must have the sale recorded in the drainage assessment book. Assessments become liens on levied bonds. The procedures for suits in chancery to collect assessments are established. The method of assessing public taxes for tracts partly within and partly without the drainage district limits is enumerated. Specific provisions cover the sale of land for public taxes, the distribution of proceeds from such sale and the right of redemption by the landowner. (Powell-Florida)
W70-03584

DRAINAGE SUBDISTRICTS.
Tenn Code Ann sec 70-1601 (1956).

Descriptors: *Tennessee, *Drainage districts, *Assessments, *Drainage, Legislation, Construction, Drainage systems, Benefits, Cost-benefit theory, Cost-benefit ratio, Damages, Taxes, Tax rate, Administration, Public benefits, Public health.

Any person owning lands within a drainage district, who desires to establish a subdistrict to secure more complete drainage, may file a petition with the clerk of the county court. The petition shall include a description of the lands to be affected by the subdistrict. The bond and all other proceedings, including the assessment of damages and benefits, shall be the same as for the establishment, formation, and construction of original districts and improvements. When established, the subdistrict shall become a part of the drainage system of the original drainage district and shall be under the control and supervision of the district board of directors. Such subdistricts may only be established when conducive to the public health or welfare, or to the public benefit or utility. Any special assessment for the benefit of a subdistrict shall be secon-

dary in lien and in right to the assessments of the original district. (Schram-Florida)
W70-03585

PUBLIC MILLS (FREE PASSAGE OF WATER THROUGH MILL SLUICES).
Tenn Code Ann secs 43-2222 thru 43-2225 (1964).

Descriptors: *Tennessee, *Sluices, *Obstruction to flow, *Flow, Mills, Channels, Watercourses (Legal), Navigable waters, Rivers, Navigation, Boats, Diversion, Water management, Alteration of flow, Legislation, Legal aspects.
Identifiers: *Penalties (Civil), *Steamboats.

No person, upon the pretense of an exclusive right of navigation by steamboat, shall obstruct the passage of water in a sluice of a river on which a mill has been erected so as to affect the profitable enjoyment of the mill. Fines are provided for offenders who divert water from such sluices. Water may be diverted from sluices into the main channel in order to secure the immediate passage of boats, but such diversion shall not last longer than half a day. No person shall obstruct navigation of navigable waters on which exclusive navigational rights to steamboat have been given. (Duss-Florida)
W70-03592

STATE HIGHWAY SYSTEM.

Mo Ann Stat secs 227.080, 227.120, 227.140, 227.150 (1952).

Descriptors: *Missouri, *Highways, *Roads, *Bridges, Legislation, Local governments, Construction. Maintenance, Condemnation, Compensation, Damages, Navigable streams, Drainage ditches, Channels, Channel improvement, Water supply, Power plants, Highway relocation, Road construction, Access routes, Right-of-way, Bridge construction, Excavation, Grading, Administrative agencies.
Identifiers: *Highway maintenance.

Certain bridges built over navigable streams and intersecting state highways are declared to be part of the state highways. These bridges shall be maintained by the state Highway Commission. When necessary for the proper and economical construction and maintenance of state highways, the Highway Commission may purchase, lease, or condemn lands for the purpose of: (1) acquiring bridges or bridge sites and ferries over navigable streams; (2) changing the channels of any stream and providing necessary drainage ditches; (3) acquiring rights of way for locating, constructing, improving, or maintaining any state highway; (4) acquiring water supply and water power sites; (5) acquiring lands to deposit excess excavated material; (6) changing gradients in any state highway; (7) establishing detours in connection with state highway improvements; and (8) eliminating grade crossings. In any condemnation proceeding, the court shall take into consideration the benefits to be derived by the landowner as well as any damages sustained. (Schram-Florida)
W70-03603

INUNDATED HIGHWAYS.

Mo Ann Stat secs 227.270, 227.280 (1952).

Descriptors: *Missouri, *Highways, *Flooding, *Highway relocation, Legislation, Damages, Local governments, Compensation, Hydroelectric plants, Hydroelectric power, Power plants, Flood damage, Legal aspects, Administrative agencies, Construction, State governments, Safety, Negotiations.

Whenever the construction or operation of any water power or hydroelectric project results in the inundation of any portion of a state highway, the State Highway Commission may abandon that portion of the highway. The Commission may then relocate as much of the highway as is necessary. Provisions as to these relocations are detailed. Whenever the construction or operation of any water power of hydroelectric project results in the inundation of any land or highway under the control and supervision of the Commission, the Highway Commission may negotiate and agree to a settlement with the responsible parties. All money received for damages from such settlements shall be deposited with the State Treasurer to the credit of the State Road Fund. (Schram-Florida)
W70-03604

MAINTENANCE OF PUBLIC ROADS.
Mo Ann Stat secs 231.080, 231.090, 231.100 (1952).

Descriptors: *Missouri, *Highways, *Maintenance, *Drainage, Legislation, Roads, Drains, Ditches, Water conveyance, Legal aspects, Real property, Obstruction to flow, Construction, Hydroelectric power, Hydroelectric plants, Powerplants, Flooding, Local governments, Jurisdiction, Compensation, Flood damage, Drainage practices, Drainage engineering.
Identifiers: *Highway maintenance.

The county highway engineer is authorized to contract with any owner of land adjacent to a public road for the purpose of opening any ditch for the drainage of the road. Reasonable compensation may be paid. These contracts shall be in writing and shall describe the lands on which said ditches or drains are situated. These contracts shall be signed by the landowner and recorded in the office of the county deed recorder. Whenever any ditch has been opened pursuant to this section, the road overseer or county highway engineer may enter upon such land at any time to remove any obstructions in the ditch. Any person obstructing these ditches so as to interfere with drainage purposes shall be guilty of a misdemeanor. Whenever the construction or operation of any power or hydroelectric project results in the inundation of roads other than state highways, the proper local officials having jurisdiction of such roads may make a settlement for the damages. All money received shall be credited to the road fund of the county or political subdivision. (Schram-Florida)
W70-03606

DAMS, MILLS AND ELECTRIC POWER.

Mo Ann Stat secs 236.010 thru 236.180 (1952).

Descriptors: *Missouri, *Dams, *Dam construction, *Electric power plants, Damsites, Nonnavigable waters, Ownership of beds, Damages, Flood damage, Public health, Assessments, Judicial decisions, Legislation, Navigation, Fish barriers, Fish conservation, Fish passages, Mills, Milldams, Costs, Dam failure, Electric power, Hydroelectric plants, Overflow, Legal aspects.

Any person or corporation organized to operate mills, electric power works, or other machinery may erect a dam across any non-navigable watercourse if the proposed damsite is located on their land. If such person or corporation owns the land on one side of the watercourse and part of the streambed, they may also erect a dam. The procedures and petitions necessary to construct dams in the above instances are detailed. A jury shall be composed to determine: (1) damages from the proposed dam erection; (2) whether surrounding lands would be flooded; (3) whether navigation and the passage of fish would be obstructed; and (4) whether the health of the neighborhood would be materially affected. The findings of the jury shall be reduced to writing and, if there are objections to these findings, a regular civil trial shall determine the issues. The county circuit court shall grant or refuse the petition for a dam according to its judgment of what would be most reasonable and just under all circumstances. The privilege to erect a dam is subject to the conditions that: (1) all damages and valuations assessed by the jury shall be paid; (2) the court imposed conditions as to obstructing navigation and the passage of fish shall be followed; (3) the dam and other machinery shall be completed within three years; and (4) the dam or machinery when destroyed or impaired, shall be repaired or rebuilt within three years. (Schram-Florida)
W70-03609

THE ROLE OF RESERVOIR OWNER POLICIES IN GUIDING RESERVOIR LAND DEVELOPMENT,
North Carolina Water Resources Research Inst., Raleigh.
For primary bibliographic entry see Field 06B.
W70-03616

APPOINTMENT, POWERS, AND DUTIES OF DRAINAGE BOARD.

Wis Stat Ann secs 88.17, 88.21-88.22 (Supp 1969).

Descriptors: *Wisconsin, *Drainage districts, *Drainage, *Water management (Applied), Drainage systems, Drainage programs, Federal government, Administrative agencies, Water control, Drainage practices, Levees, Construction, Condemnation, Flood protection, Water conservation, Floodways, Legal aspects, Legislation.

When a petition is filed for organization of a drainage district in a county which does not already have a drainage board, the county court may create a drainage board and appoint resident landowners to board membership. The drainage board shall be empowered: to employ engineers and other assistants as advisors in drainage matters; to purchase, or with court permission, condemn lands necessary for construction or maintenance of drainage systems; to level spoil banks or excavated materials for agricultural or highway construction purposes; and to purchase or construct such levees, bulkheads, floodways, or pumping machinery as are necessary for successful drainage or protection of a district. Subject to approval by the court, the drainage board may enter into agreements with the federal government or an agency thereof to permit drainage of land owned by the United States. The board may also obtain federal loans and with state approval enter into contracts with the federal government to accept benefits of federal flood prevention laws and federal water conservation laws. (Kelly-Florida)
W70-03618

ORGANIZATION OF DRAINAGE DISTRICTS.
Wis Stat Ann secs 88.27-88.36 (Supp 1969).

Descriptors: *Wisconsin, *Drainage districts, *Drainage programs, *Administrative agencies, Drainage, Drainage systems, Construction costs, Cost allocation, Cost-benefit analysis, Drainage, Water control, Water management (Applied), Legal aspects, Legislation, Operation and maintenance, Permits, Control.

Owners of more than one-half of the land in a given area may petition for the organization of a drainage district to serve that area. An alternate method permits a majority of the landowners within a proposed drainage district, who own at least one-third of the included land area, to petition for organization of a district. Requirements relating to petition contents and filing procedure are set forth. Special procedures are established where drainage projects will affect navigable waters. The Public Service Commission must consent to the project, and extensive investigations of the proposed project must be undertaken by the drainage board before a permit to proceed may be granted. At any time prior to approval of the creation of a drainage district, a majority of the landowners, or those owning a majority of the land in the proposed district may petition the court to refrain from establishing a district. Following the organization

of drainage district, the drainage board shall proceed to lay out sufficient drains to carry out the drainage project, and shall assess benefits to the affected land, estimate costs and award damages where appropriate. (Kelly-Florida)
W70-03628

DRAINAGE (CONTROL OF WATER ON THE SURFACE: ORGANIZATION AND OPERATION OF DRAINAGE DISTRICTS).
Ill Ann Stat ch 42, secs 12-1 thru 12-24 (Smith-Hurd 1956), as amended, (Supp 1969).

Descriptors: *Illinois, *Drainage districts, *Administrative agencies, *Surface drainage, Drains, Ditches, Spillways, Right-of-way, Condemnation, Easements, Structures, Bridges, Levees, Bridge construction, Highways, Railraods, Culverts, Flow, Flow control, Costs, Pumping plants, Wastes, Pipes, Environmental sanitation, Legislation, Interagency cooperation.
Identifiers: *Natural drains, Penalties (Civil), Fords, Penalties (Criminal).

Landowners within drainage districts have the right to use district drains for drainage of their land. Land within a district has the same rights of drainage as land outside of an organized district, except insofar as the drainage system varies from natural drainage. Landowners may continue to use land occupied by a district right-of-way in manners not inconsistent with the rights of the district. When a district drain crosses a railroad or highway, the district is liable for the construction of bridges or culverts necessitated by such crossing. Lands outside of a district may be included within it when construction of district works protects such lands. Civil and criminal penalties are provided for injuries to district structures and interference with the proper functioning of the district. The district commissioners shall cooperate with other governmental agencies in the exchange of information pertaining to drainage. This act is a consolidation of all previous state statutes relating to the organization and operation of drainage districts. (Duss-Florida)
W70-03633

MUNICIPAL CORPORATIONS (FLOOD PREVENTION).

Ind Ann Stat secs 48-4701 thru 48-4749 (1963), as amended, (Supp 1968).

Descriptors: *Indiana, *Administrative agencies, *Floods, *Flood control, Legislation, Regulation, Administration, Dams, Dikes, Diversion structures, Levees, Flood protection, Water management (Applied), Management, Planning, Costs, Construction costs, Condemnation, Financing, Taxes.

The board of public works of any first class city may adopt a resolution declaring the carrying out of flood control projects to be necessary for the general welfare. The board has the power to: construct dikes, levees, and retaining walls along rivers or streams; remove obstructions in channels; and construct and repair bridges. Other powers relevant to flood protection and water control are listed, and include the powers to: establish channel, bank, and harbor lines on rivers and streams; control the removal of obstructions; and regulate the construction of temporary bridges dikes, spillways, and dams. The board may condemn property needed for flood control purposes. A city and county tax levy to pay for bond issues is authorized. The organization of the Board of Flood Control Commissioners is set forth. The Commission has the power to: carry out flood control projects; construct dikes and levees; provide for disposal of excess reservoir water; and dredge, control or change the channel of streams. The county surveyor controls and manages all levees constructed. (Moulder-Florida)
W70-03634

WATER SUPPLY - SANITATION - DITCHES (ORGANIZATION AND PURPOSES OF CONSERVANCY DISTRICTS).
Ohio Rev Code Ann sec 6101.04 (Page 1953).

Descriptors: *Ohio, *Conservation, *Regulation, *Administrative agencies, Erosion, Streams, Lake Erie, Environmental sanitation, Water supply, Irrigation, Flood control, Legislation, State governments, Water conservation, Erosion control, Reservoirs, Land reclamation, Multiple-purpose projects, Sewage, Sewage systems, Sewage districts, Ditches, Irrigation ditches, Drainage engineering.

Any area or areas situated in one or more counties may be organized as a conservancy district. These districts shall be subject to conditions stipulated in other sections of this act. The following shall be the purposes of these districts: preventing floods; regulating stream channels by changing their dimensions; providing for irrigation where needed; reclaiming or filling wet and overflowed lands; regulating the flow of streams and diverting or wholly eliminating watercourses; providing a water supply for domestic use; collecting and disposing of sewage; and arresting erosion along the Ohio shoreline of Lake Erie. (Barnett-Florida)
W70-03643

4B. Groundwater Management

INJECTION WELL EXPERIENCE AT RIVERHEAD, N.Y.,
Baffa (John J.), New York.
John J. Baffa.
Journal of American Water Works Association, Vol 62, No 1, p 41-46, Jan 1970. 6 p, 9 fig, 5 ref.

Descriptors: *Injection wells, *Water reuse, *Recharge wells, Model studies, Reclaimed water, Aquifers, Water yield, Permeability, Recharge, Artificial recharge.
Identifiers: Well clogging, Well performance.

Injection of fresh potable water was studied in the field and laboratory to compare the hydraulic characteristics of the injection mound with the pumping drawdown characteristics. Injection requires establishment of a boundary pressure for entrance of the injection water into the aquifer pores. Injection was accomplished in two ground wells of different design and in two wells contained in a ground simulator tank so constructed as to permit the sampling of the aquifer material opposite the well screen after pumping, injection and redevelopment. The clogging rate of the double-cased well was less than that of the single-cased well by 0.06 ft per day as measured by the water level inside the casing. The initial specific capacity of the double-cased well was about half of the well with the gravel pack, but after fresh water injection and reclaimed waste water injection it was possible to restore its initial capacity by surging and pumping. After reclaimed waste water injection into the single-cased well its specific capacity was markedly reduced and could not be restored. (Knapp-USGS)
W70-03249

HYDROLOGIC RECONNAISSANCE OF THE BEAR RIVER BASIN IN SOUTHEASTERN IDAHO,
Geological Survey, Boise, Idaho.
For primary bibliographic entry see Field 02F.
W70-03254

FLOW OF FRESH WATER TO DRAINS IN A COASTAL AQUIFER,
Asian Inst. of Technology, Bangkok (Thailand). Dept. of Engineering.
Hung Tao Shen.
Master of Engineering Thesis, No 248, Asian Institute of Technology, 1969. 62 p, 10 fig, 3 tab, 22 ref.

Descriptors: *Dimensional analysis, *Aquifers, *Flow, Drains, Fresh water, Saline water, Piezometers, Withdrawal, Pumping, Pump testing, Boundary processes, Density, Water level.
Identifiers: *Coastal aquifer, Two-dimensional study.

A two-dimensional study was made of flow conditions caused by pumping from a fresh-water aquifer bounded on the lower surface by a stationary fluid of higher density (saline water) and on the upper surface by a horizontal plane having a constant piezometric head. Withdrawal of fresh water was accomplished by continuous pumping from a series of line sinks or drains spaced at periodic intervals in the fresh water area. Pumping produced interface upconing in the vicinity of the line sink. A general rising of the level of the fresh water-salt water boundary resulted when compared to conditions which existed prior to pumping. The results of mathematical analysis describing flow conditions is presented graphically in dimensionless form. (Carstea-USGS)
W70-03257

GROUNDWATER CONDITIONS IN THE RANEGRAS PLAIN, YUMA COUNTY, ARIZONA,
Geological Survey, Phoenix, Ariz.
P. C. Briggs.
Arizona State Land Department Water-Resources Report No 41, Sept 1969. 28 p, 7 fig, 4 tab, 8 ref, append.

Descriptors: *Water resources, *Arizona, *Groundwater, *Groundwater basins, Water wells, Aquifers, Water yield, Water quality, Irrigation water, Irrigation, Water levels, Water level fluctuations, Hydrologic data, Data collections, Hydrogeology.
Identifiers: Yuma County (Ariz).

In the Ranegras Plain, Arizona, nearly all the cultivated acreage and groundwater pumped are within an area of about 200 square miles north of U.S. Highway 60-70 and south of Bouse. The first large irrigation wells were drilled in the plain in 1948. By spring 1949, about 1,000 acres were being irrigated; by 1957 the amount of land being irrigated had increased to 5,200 acres, but by 1967 only 2,800 acres were being irrigated. From 1948 through 1967, about 211,000 acre-ft of groundwater was pumped in the Ranegras Plain. Changes in water level resulting from the pumping have been minor to the present time (1967). Water levels have declined more than 15 ft in only a small part of the area; declines in water level of from 10 to 15 ft have occurred in a fairly large area. The groundwater in the Ranegras Plain contains varying amounts of dissolved minerals and is considered permissible to unsuitable for irrigation. (Knapp-USGS)
W70-03267

A STUDY ON THE RECESSION ON UNCONFINED AQUIFERS,
For primary bibliographic entry see Field 02F.
W70-03274

GROUNDWATER RESOURCES OF ASH SHATI' AREA, KINGDOM OF LIBYA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02F.
W70-03306

WATER WELLS.

Tenn Code Ann secs 70-2301 thru 70-2310 (Supp 1969).

Descriptors: *Tennessee, *Water wells, *Drilling, *Well regulations, Wells, Well permits, Permits, Underground, Groundwater, Water sources, Water supply, Conservation, Administration, Administrative agencies, Regulation, Legal aspects, Water

policy, Water conservation, Water resources, Legislation, Water management (Applied).

Every person who intends to drill or dig a water well within the state shall annually obtain a state license. It shall be unlawful for any person to drill or dig a water well within the state without being licensed, posting a certificate furnished by the Commissioner of Conservation and filing a 'report of well driller' after the completion of each well. All water well drilling must be supervised and managed by a licensed water well driller. Well drilling licenses may be suspended or revoked for enumerated reasons. The Commissioner of Conservation is authorized to make and publish such rules and regulations as he deems necessary to effectuate this chapter. A Board of Ground Water Resources is hereby created in order to advise and assist the Commissioners in preparation of rules and regulations governing water well drilling. This chapter applies solely to wells drilled for the production of water. Any violation of this chapter shall be a misdemeanor. (Smith-Florida)
W70-03424

RECONNAISSANCE APPRAISAL OF THE WATER RESOURCES NEAR ESCALANTE, GARFIELD COUNTY, UTAH,
Utah Univ., Salt Lake City. Dept. of Geological and Geophysical Sciences.
For primary bibliographic entry see Field 02F.
W70-03454

4C. Effects on Water of Man's Non-Water Activities

GREAT SALT LAKE, UTAH: CHEMICAL AND PHYSICAL VARIATIONS OF THE BRINE, 1963-1966,
Geological Survey, Salt Lake City, Utah.
For primary bibliographic entry see Field 02H.
W70-03279

MULTI-MEANS EFFORT FOR URBAN FLOOD CONTROL,
Wright-McLaughlin Engineers, Denver, Colo.
Kenneth R. Wright.
Paper presented at International Conference on Floods: Their Protection and Defense of the Soil, held by the Accademia Nazionale Dei Lincei, Rome, Italy, Nov 1969. 28 p, 24 ref.

Descriptors: *Flood control, *Planning, *Drainage systems, *Drainage engineering, Storm drains, Storm runoff, Drainage programs, Hydraulic structures, Water policy, Floodproofing, Flood protection.

Most urban areas are faced with a flood problem that receives little official recognition, the urban drainage problem. Urban drainage is usually very localized, although it is believed that damages due to urban drainage problems are equal to report flood losses. AN EFFECTIVE WAY TO DEAL WITH THIS PROBLEM IS BY A MULTIPLE MEANS EFFORT BASED ON A BASIC URBAN DRAINAGE POLICY. This policy should be formulated in light of various inputs; principles of urban drainage, hydrology and hydraulics of small urban basins, and accurate knowledge of urban drainage law. Urban drainage policy must also recognize that urban drainage is directly related to the total urban system and that when it is deficient, adverse effects occur in other subsystems. The planning process is based on the concept of two urban drainage systems. The initial drainage system, typically storm sewers, is designed to handle storm runoff expected to occur once every 2-10 years. The major drainage system is the area which must accommodate the 100-year runoff and includes both natural and artificial elements. Other specific aspects of urban drainage planning discussed are functions of storm sewers and streets, hydraulic structures, inlets and culverts, storage, and floodproofing. (Davis-Chicago)
W70-03343

WATER RESERVOIR SYSTEMS.
Autonetics Division of North American Rockwell Corporation, Anaheim, California, Life Sciences Operations.
For primary bibliographic entry see Field 04A.
W70-03435

WATER AND MAN: A WORLD VIEW,
Geological Survey, Washington, D.C. Water Resources Div.
For primary bibliographic entry see Field 06G.
W70-03450

ARROGANCE TOWARD THE LANDSCAPE: A PROBLEM IN WATER PLANNING,
Geological Survey, Washington, D.C. Water Resources Div.
For primary bibliographic entry see Field 06G.
W70-03465

4D. Watershed Protection

CONSERVATION OF NATURAL RESOURCES (SHORE EROSION).

Ohio Rev Code Ann secs 1507.01 thru 1507.13 (Page 1964), as amended, (Supp 1970).

Descriptors: *Ohio, *Beach erosion, *Shore protection, *Erosion control, Legislation, Legal aspects, Shores, Erosion, Construction, Structures, Permits, Riparian land, Financing, Rivers and Harbors Act, Administrative agencies, Natural resources, Water resources, Federal government, Lake Erie, Investigations, Navigable waters, Taxes, Mineralogy, Watercourses (Legal), Cost allocation, Contracts, Planning, Recreation.
Identifiers: Groins.

The Office of the Chief Engineer of the Department of Natural Resources will act as the erosion agency of the state for purposes of complying with the Rivers and Harbors Act. The Office will cooperate with the Federal Beach Erosion Board in conducting investigations and studies along the shores of Lake Erie with a view to erosion prevention and correction. Navigable waters, for the purpose of this section, means waters within the jurisdiction of the Board and any waterways within or adjacent to the state. No person will construct a beach or any other erosion arresting structure on the shores of Lake Erie without a permit from the Office. Funds for erosion projects will be obtained from permit sales and Lake Erie mineral leases. The Office may enter into agreements with any political subdivision for the purpose of constructing and maintaining projects to prevent, correct, and arrest erosion on specified beaches. Cost allocation formulas are provided for the different governmental subdivisions. The Chief Engineer in cooperation with the Division of Geological Survey, will prepare a plan for the prevention of shore erosion in the state. (Keith-Florida)
W70-03405

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

SOME WATER QUALITY ASPECTS OF THE UPPER ROANOKE RIVER BASIN WITH SPECIAL EMPHASIS ON TEMPERATURE,
Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center.
For primary bibliographic entry see Field 05C.
W70-03244

NONIONIC POLYMER FLOCCULATION OF DILUTE CLAY SUSPENSION,
Maryland Univ., College Park. Dept of Civil Engineering; and Federal Water Pollution Control Administration, Washington, D.C.
Francis B. Birkner, and J. K. Edzwald.
Journal of American Water Works Association, Vol 61, No 12, p 645-651, Dec 1969. 7 p, 6 fig, 5 tab, 21 ref.

Descriptors: *Water chemistry, *Flocculation, *Clays, Chemical precipitation, Coagulation, Ion exchange, Desilting, Water treatment.
Identifiers: Polyethylene oxide.

In a search for more efficient flocs, the chemical and physical mechanisms which are involved in the destabilization of kaolinite clay suspensions with a nonionic polymer, were examined. Polyethylene oxide was specifically tested as a flocculant. Solution pH and the type of counterion which predominates in the solution phase have a significant effect on the adsorption of polyethylene oxide onto kaolinite clay surfaces. Under conditions of constant ionic strength and at pH 8.3, twice as much polymer adsorption occurs when sodium ions are the predominant cation species in the solution phase than when calcium ions predominate. Adsorption is significantly reduced by raising the solution pH from 8.3 to 12 or by lowering it to 2.5. Polyethylene oxide was found to enhance turbidity removal when used in conjunction with sodium (Water I) or calcium (Water II) ions. (Knapp-USGS)
W70-03265

HYDROGEN SULFIDE ODOR THRESHOLD,
Pomeroy, Johnston and Bailey, Pasadena, Calif.
Richard D. Pomeroy, and Henry Cruse.
Journal of American Water Works Association, Vol 61, No 12, p 677, Dec 1969. 1 p, 1 tab.

Descriptors: *Odor, *Hydrogen sulfide, *Water quality, Laboratory tests, Water chemistry, Hydrogen ion concentration.
Identifiers: *Hydrogen sulfide odor determination.

Tests were made to ascertain the minimum concentration at which the odor of hydrogen sulfide in water can be detected. A panel of five observers was used, only one of whom had prior experience in odor testing. The odor threshold concentration of hydrogen sulfide in water at ordinary temperatures is in the range of 10 to 100 nanograms/liter (0.00001 to 0.0001 mg/l. It is noteworthy that the odor that one detects at very low hydrogen sulfide concentrations is musty or swampy, not recognizable as being related to the characteristic odor at higher concentrations. A musty odor is often complained of in anaerobic groundwaters. Hydrogen sulfide is a characteristic constituent of such waters, typically at concentrations below 0.1 mg/l. (Knapp-USGS)
W70-03275

DETERMINING pH OF STRIP-MINE SPOILS,
Forest Service (USDA), Berea, Ky. Northeastern Forest Experiment Station.
W. A. Berg.
US Forest Service Research Note NE-98, 1969. 7 p, 1 fig, 1 tab, 2 ref.

Descriptors: *Hydrogen ion concentration, *Acidic soils, *Strip mine wastes, *Analytical techniques, Mine wastes, Acidic water, Acid mine water, Water pollution sources.
Identifiers: Strip mine spoils.

In determining pH of strip-mine spoil, results with the LaMotte-Morgan method for determining soil pH (or the solution modification of this method) usually agreed fairly well with the results from using a pH meter, the recognized standard. Results obtained with the Soiltex and Hellige-Truog methods often deviated somewhat from the pH meter readings; and the Hydrion papers and the Kelway pH tester often gave results that were considerably different. (Knapp-USGS)
W70-03281

MEASUREMENT OF PHOSPHORUS IN WASTEWATER,
Belgrade Univ. (Yugoslavia) and Washington Univ., St. Louis, Mo. Dept. of Civil and Environmental Engineering.
Stevan G. Jankovic, Dee T. Mitchell, and James C. Buzzell, Jr.
Water and Sewage Works, Vol 114, No 2, p 471-474, 1967. 2 fig, 3 tab, 11 ref, appendix.

Descriptors: *Analytical techniques, *Sewage, *Phosphorus, Filtration, Industrial wastes, Sewage.
Identifiers: Orthophosphates, Phosphorus (Total), Dry-ashing, Polyphosphates, Murphy-Riley method, Domestic sewage.

Method of phosphorus determination in sewage waters in utilizing ascorbic acid as a reducing agent thereby avoiding complications caused by the use of stannous chloride is described. Neither pH value of the medium, nor additions of small amounts of oxidizing or reducing agents produced appreciable modification of results. Results comparable to dry-ashing were obtained by wet oxidation with potassium persulfate. The method is intended for analysis of domestic sewage and the results may be distorted by the presence of certain ingredients of industrial discharges. (Wilde-Wisconsin)
W70-03331

NEUTRON ACTIVATION ANALYSIS IN WATER RESOURCES MANAGEMENT IN NORTH CAROLINA,
North Carolina Water Resources Research Inst., Raleigh.
James R. Bohannon, Jr., Kuruvilla Verghese, and Jack N. Weaver.
Available from the Clearinghouse as PB-189 161, $3.00 in paper copy, $0.65 in microfiche. Report No 31, Water Resources Research Institute of The University of North Carolina, Dec 31, 1969. 142 p, 21 tab, 43 fig. OWRR Project A-0390-NC.

Descriptors: *Analytical techniques, *Water analysis, *Neutron activation analysis, Neutron spectroscopy, Neutron absorption.

A deliberate exploratory study and pilot plant type series of analysis were carried out to determine the applicability of neutron activation analysis (NAA) to water resources research and management in North Carolina. A review of the water pollution problems and programs was made to establish the background for determining this applicability. An explanation of the NAA technique is presented to prepare the reader for an understanding of the character of past water pollution programs and studies which employed the NAA technique. With this basic understanding established, applicability of NAA to North Carolina water resources problems was identified and specific exploratory analysis were performed. The categories of analysis were: the determination of baseline for trace elements in both virgin and contaminated rivers within the State, the establishment of minimum detection limits of specific trace elements of concern to the State by seeding the original water samples, and the performance of in-line process analysis for several industries. It was found that instrumental NAA could indeed be used to establish meaningful baselines for the water sources in the State, the minimum detectable limits were equal to or better than conventional methods in most cases, and NAA could serve a major role in the solution of water pollution problems and abatement within the desired criteria of routine, inexpensive and rapid analysis. The latter is particularly useful to the industries of the State in their efforts to recover wastes and to minimize their release by in-line process analysis. The detection problems and levels of specific types of pollutants; namely, pesticides, herbicides, and fungicides were explored. Specific recommendations were given on the future application of NAA to North Carolina water resources management. An extensive bibliography was developed. (Howells-North Carolina Univ)
W70-03351

IDENTIFICATION OF RETURN IRRIGATION WATER IN THE SUBSURFACE: WATER QUALITY,
Hawaii Univ., Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 05B.
W70-03430

A WATER MONITORING SYSTEM FOR PESTICIDES IN NORTH CAROLINA,
North Carolina State Univ., Raleigh. Pesticide Residue Research Lab.
For primary bibliographic entry see Field 05B.
W70-03437

OFFSITE RADIOLOGICAL SURVEILLANCE FOR PROJECT GASBUGGY, JUNE 1967-JULY 1968,
Southwestern Radiological Health Lab., Las Vegas, Nev.
John R. McBride, and Dixon Hill.
Radiological Health Data and Reports, Vol 10, No 12, p 535-546, Dec 1969. 12 p, 7 fig, 7 tab, 2 ref.

Descriptors: *Nuclear explosions, *Water pollution sources, *Radioactivity, *Monitoring, Sampling, Nuclear engineering, Underground, Natural gas, Water wells, Oil fields.
Identifiers: Project Gasbuggy.

Project Gasbuggy, an experiment to stimulate gas recovery by nuclear means, was conducted on December 10, 1967, as part of the Atomic Energy Commission's (AEC) Plowshare Program. The Public Health Service by Memorandum of Understanding with the AEC is responsible for a comprehensive offsite radiological safety program. The data obtained during this program have documented that no radioactivity was introduced into the environment as a result of the Project Gasbuggy detonation. Surveillance of the El Paso natural gas producing wells near the Gasbuggy experiment was conducted to insure that gas contaminated with radioactivity was not present. Water sampling coverage during the preshot and post-shot periods was provided by a network of 34 sampling stations. Fifteen of the sampling locations were within 20 miles of ground zero at open- and well-water sources, and 13 of the locations were milk cow sampling stations. Six of the network locations were municipal water systems located within approximately 120 miles from ground zero. (Knapp-USGS)
W70-03452

DETERMINATION OF MICROGRAMME QUANTITIES OF DISSOLVED SULPHATE IN SURFACE WATERS, SOILS AND PLANTS,
Commonwealth Scientific and Industrial Research Organization, St. Lucia (Australia). Cunningham Lab.
I. P. Little, R. Reeve, G. M. Proud, and Ann Lulham.
Journal of the Science of Food and Agriculture, Vol 20, No 11, p 673-676, 1969. 2 fig, 3 tab, 8 ref.

Descriptors: *Analysis, *Sulfur, Surface waters, Soil water, Plant tissues, Spectrophotometry, Analytical techniques.
Identifiers: *Dissolved sulphate.

A simple method for rapid determination of sulphate in surface waters and soil water extracts has an accuracy of 1 part per million. The sulphate is precipitated with a solution of lead nitrate in 40% ethanol. The residual lead is determined by atomic absorption spectrophotometer. Analysis of plant tissues requires conversion of sulphur to dissolved sulphate by combustion in an oxygen-filled flask. (Wilde-Wisconsin)
W70-03502

DISSOLVED ORGANIC MATTER IN AN ANOXIC FJORD, WITH SPECIAL REFERENCE TO THE PRESENCE OF MERCAPTANS,
Dalhousie Univ., Halifax (Nova Scotia). Inst. of Oceanography; and Washington Univ., Seattle. Dept. of Oceanography.
For primary bibliographic entry see Field 05B.
W70-03503

HYPOLIMNETIC HEATING IN CASTLE LAKE, CALIFORNIA,
California Univ., Davis. Dept. of Zoology.
Roger W. Bachman, and Charles R. Goldman.
Limnology and Oceanography, Vol 10, No 2, p 233-239, Apr 1965. 6 fig, 1 tab, 13 ref.

Descriptors: *Thermal stratification, *Solar radiation, *Hypolimnion, *Turbulent flow.
Identifiers: *Eddy conductivity.

Caculations were made of the coefficient of eddy conductivity by making use of a series of summer temperature profiles of a small mountain lake. An electrical resistance thermometer was used to measure water temperature at a station in the deepest portion of the basin. A minimal series included temperatures at 1-m intervals from the surface to 10-m and at 5-m intervals from 10-m. to the bottom. Solar radiation was measured with a pyrheliograph and pyrheliometer, water transparency was with a Secchi disc and light penetration was measured by a G.M. underwater photometer with various Schott light filters. The relatively high value obtained (0.0622g/cm/sec) prompted an evaluation of the role of direct solar heating in the hypolimnion using data on total daily solar radiation, the spectral curve of sunlight, and the light transmission properties of the lake water. An estimated 65-85% of the heating in the upper hypolimnion could be accounted for by direct solar heating. It is postulated that in Castle Lake, direct solar heating rather than turbulent mixing is responsible for the shape of the hypolimnetic thermal profile. (Guerrero-Vanderbilt)
W70-03551

5B. Sources of Pollution

SOME WATER QUALITY ASPECTS OF THE UPPER ROANOKE RIVER BASIN WITH SPECIAL EMPHASIS ON TEMPERATURE,
Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center.
For primary bibliographic entry see Field 05C.
W70-03244

GREAT LAKES NEARSHORE MODELLING FROM CURRENT METER DATA,
Ontario Water Resources Commission, Toronto.
M. D. Palmer, and J. B. Izatt.
Ontario Water Resources Commission Final Report on Great Lakes Water Quality Surveys Program, 1969. 57 p, 13 fig, 11 tab, 8 ref, 2 append.

Descriptors: *Dispersion, *Currents (Water), *Great Lakes, *Current meters, *Mathematical models, Waste dilution, Data collections, Hydrologic data, Mixing, Sewage disposal, Thermal pollution, Heated water.
Identifiers: Nearshore currents (Great Lakes).

Methods for the prediction of the dispersion patterns resulting from the continuous discharge of waste in the nearshore areas of lakes are developed. These methods are based upon the analysis of recording current meter records. The long-term dispersion characteristics are presented as monthly mean concentration contours for various discharges. The short-term characteristics are presented as five-hour probabilities and dilution rates for the four major compass directions. (Knapp-USGS)
W70-03253

KARSTIC WATER RESEARCH IN HUNGARY,
Research Inst. for Water Resources Development, Budapest (Hungary). Karstic Water Research Section.
For primary bibliographic entry see Field 02F.
W70-03264

QUALITY OF SURFACE WATERS OF SOUTH CAROLINA: A SUMMARY OF DATA, 1945-1968,
Geological Survey, Columbia, S.C.
T. Ray Cummings.
Copies of report may be obtained from U.S. Geological Survey, Water Resources Div, 2346 Two Notch Road, Columbia, S.C. 29204. Geol Surv Basic Data Open-file Report, 1969. 34 p, 4 fig, 1 plate, 3 tab, 15 ref.

Descriptors: *Water quality, *South Carolina, *Data collections, Hydrologic data, Water chemistry, Solutes, Mineralogy.
Identifiers: Water quality data.

Maximum and minimum values of dissolved substances and physical properties of surface water at 81 locations in South Carolina are tabulated. Most dissolved substances are in low concentration, and measured values of physical properties are low. At most sampling stations dissolved-solids content does not exceed 100 mg/l. South Carolina is divided into two water-quality zones, which generally correspond to the Piedmont province and Coastal Plain province of the State. Minor but distinct differences between water of these zones occur. Water of the Piedmont province contains slightly more dissolved solids, particularly silica, sodium, and bicarbonate, than does water from the Coastal Plain province. The pH of water in the Piedmont province is also slightly higher. The color of water, however, averages about 100 units higher in the Coastal Plain province than in the Piedmont province. (Knapp-USGS)
W70-03266

WATER QUALITY IN THE DRAINAGE AREA OF THE DELAWARE RIVER (DUTCH),
Rijksinstituut voor Zuivering van Afvalwater, Voorburg (Netherlands).
W. A. H. Brouwer.
H2O, Vol 2, No 17, p 400-402, Aug 21, 1969. 3 p, 2 fig, 1 photo, 1 map, 5 ref.

Descriptors: *Water quality, *Estuaries, *Delaware River, *Delaware River Basin Commission, *Water quality control, Estuarine fisheries, Estuarine environment, Regulation, Legislation, Legal aspects, Interstate, Water resources development, Planning, River basin commissions, Maryland, New Jersey, New York, Pennsylvania.
Identifiers: *Delaware River Basin.

The Delaware River drains a region of ample water resources. A multiplicity of water quality management problems exist encompassing protection of municipal and industrial water supplies, acid mine drainage control, recreation and water sports, saline waters encroachment in a tidal estuary, natural shellfish beds in Delaware Bay, maintenance and propagation of resident fish, passage of anadromous fish and the discharge and ultimate disposal of the generally treated wastes from 6.5 million people and numerous industries. In 1961 a compact gave rise to the Delaware River Basin Commission, formed by the four Basin States and the Federal Government. Part of the Commission's responsibilities in the maintenance of a Comprehensive Plan of water resource development, including water quality management. A 5-year study in the complex estuary provides a framework for decisions which will protect the desired uses as well as allow reasonable waste discharges. (Knapp-USGS)
W70-03269

POSSIBILITIES FOR MINERALIZATION OF PESTICIDES (DUTCH),
For primary bibliographic entry see Field 05G.
W70-03271

POISONING THE WELLS.
Committee for Environmental Information, St. Louis, Mo.

Environment, Vol 11, No 1, p 16-23, 45, Jan-Feb 1969. 9 p, 5 fig, 2 photo.

Descriptors: *Water chemistry, *Leaching, *Nitrates, *Fertilizers, Water pollution sources, Irrigation, Irrigation water, Irrigation practices, Nitrogen compounds, California.
Identifiers: Delano (Calif), Drinking water.

Nitrate contamination of well water in the vicinity of Delano, California is caused by leaching of agricultural fertilizer from the soil by irrigation water. About 450 lbs of fertilizer is applied to each irrigated acre. Without proper drainage facilities, contamination will increase. Nitrate contamination is now so high that municipal water system managers had to issue warnings against use of their water for infants. (Knapp-USGS)
W70-03276

IDENTIFICATION OF RETURN IRRIGATION WATER IN THE SUBSURFACE: WATER QUALITY,
Hawaii Univ., Honolulu. Water Resources Research Center.
Pedro A. Tenorio, Reginald H. F. Young, and H. Collins Whitehead.
Available from the Clearinghouse as PB-189 171, $3.00 in paper copy, $0.65 in microfiche. Hawaii Water Resources Research Center, Technical Report No. 33, Oct 1969. 90 p, 2 tab, 28 fig, 39 ref. OWRR Project B-012-HI.

Descriptors: *Groundwater, Nitrates, Dissolved solids, *Return flow.
Identifiers: *Irrigation return water, Pearl Harbor-Waipahu (Oahu), Kahuku (Oahu), Central Maui, West Maui.

A joint research effort was undertaken by the Water Resources Research Center and the Honolulu Board of Water Supply to investigate the physical and chemical characteristics of irrigation return water in Pearl Harbor-Waipahu, Oahu, which is an area used for tropical agriculture. The project was started in 1967 and was expanded in 1968 to include Kahuku, Oahu and Central and West Maui. Well samples and profile samples were obtained with a thief sampler in the Pearl Harbor-Waipahu area and composite samples were obtained mainly from pumping wells in other areas. In addition, both spring and stream waters in the Pearl Harbor-Waipahu area were analyzed for a number of inorganic constituents. Stream waters in the main study area were observed to contain appreciable quantities of nitrate, phosphate, bromide, bicarbonate, and fluoride. Similar trends were observed with the spring samples including increases of calcium, magnesium, silica, sulfate, and nitrate. Well waters from the main study area were evaluated according to Visher and Mink's index constituents, silica, sulfate, and nitrate, and other significant ionic compositions. General analysis of major constituents evidenced a cyclical trend in concentration, either related to seasonal rainfall and irrigation practices, or both. (WRSIC-Abstract)
W70-03430

OXYGENATION OF FERROUS IRON: THE RATE-DETERMINING STEP IN THE FORMATION OF ACIDIC MINE DRAINAGE,
Harvard Univ., Cambridge, Mass. Dept. of Applied Chemistry.
Philip C. Singer, and Werner Stamm.
Available from the Clearinghouse as PB-189 233, $3.00 in paper copy, $0.65 in microfiche. Federal Water Pollution Control Administration Research Series Report DAST-28, June 1969. 199 p, 63 fig, 10 tab, 122 ref, 6 append. FWPCA Contract PH 36-66-107. Program 14010.

Descriptors: *Acid mine water, *Oxidation, *Pyrite, *Iron bacteria, *Chemical reactions, Water chemistry, Mine acids, Water pollution sources, Acidic water, Reduction (Chemical), Hydrogen ion concentration, Oxidation-reduction potential, Sulfides, Iron.
Identifiers: Reaction kinetics.

The rate of oxidation of iron (II) by oxygen conforms to a relationship which is first-order in the concentrations of ferrous iron and oxygen, and second-order in the concentration of hydroxide ion, at pH values between 6.0 and 7.5. The reaction proceeds relatively rapid at pH values greater than 6.5; the half-time of the reaction is 4 minutes at pH 7.0, under a partial pressure of oxygen of 0.20 atmospheres at 25 deg C. The dependence of the oxidation rate on hydroxide concentration has been observed, in this study, at pH values as low as 4.5, where the half-time has increased to approximately 300 days. At lower pH values, the dependence of the reaction rate on pH becomes less marked until at pH values below 3.5, the oxidation proceeds at a rate which is independent of pH. Field results suggest that the observed rapidity of the reaction in acidic mine waters is apparently the result of microbial catalysis. The rate-limiting step among the reactions involved in the oxidation of iron pyrite and the production of acidity in mine drainage waters is the oxygenation of ferrous iron. Oxidation of iron pyrite is by a cyclical reaction involving the slow oxygenation of iron (II) to iron (III) followed immediately by the rapid reduction of iron (III) by pyrite, generating in turn more iron (II) and acidity. (Knapp-USGS)
W70-03434

A WATER MONITORING SYSTEM FOR PESTICIDES IN NORTH CAROLINA,
North Carolina State Univ., Raleigh. Pesticide Residue Research Lab.
T. J. Sheets, M. D. Jackson, and L. D. Phelps.
Available from the Clearinghouse as PB-189 291, $3.00 in paper copy, $0.65 in microfiche. Progress Report No. 19, Water Resources Research Institute of The University of North Carolina, Feb 6, 1970. 105 p. OWRR Project A-021-NC.

Descriptors: *Pesticides, *Pesticide monitoring, *Water quality, *Pesticide residues, Insecticides, Herbicides, *Chlorinated hydrocarbons, DDT, TDE, DDD, Phenoxy herbicides, 2-4-D, 2-4-5-T, Trifluraline, Pollutants, Water, Sediment, Estuaries, Pesticide use estimates.
Identifiers: *Phenoxy acetates, *Water and sediment.

A procedure for monitoring surface waters in North Carolina for pesticides was devised and tested in the Tar-Pamlico River. Sites, positions in the river, frequencies, and kinds of samples were evaluated. Samples of sediment and water were routinely taken from the river and from selected sites in estuaries and sounds and analyzed by electron-capture gas chromatography for p,p'-DDT, p,p'-TDE, o,p-DDT, p,p'-DDE, and dieldrin. The p-value was evaluated as a method of confirmation. The low limits of detection of each of the pesticides were 10 ppt and 4 ppb for water and sediment, respectively. The percent positive values in sediment were 10 to 10,000 times greater than levels in water. Systems for sampling and analyzing water and sediment for chlorinated hydrocarbons, organic phosphates, phenoxy acetates, and trifluraline were outlined, and minimum personnel and equipment needs for operation of the monitoring system were listed.
W70-03437

A NEW POLLUTION PROBLEM,
Committee for Environmental Information, St. Louis, Mo.
Sheldon Novick.
Environment, Vol 11, No 4, p 2-9, May 1969. 8 p, 3 photo, 2 tab.

Descriptors: *Water pollution sources, *Pesticides, *Fungicides, Metal organic pesticides, Pesticide toxicity, Poisons, Public health.
Identifiers: Mercury compounds.

Mercury pesticides are widely used in agriculture and potentially can result in toxic residues in foods. These pesticides and fish contaminated by them have been banned in Sweden; the pattern of use in the U. S. is like that in Sweden before the ban. Mercury pesticides manufacturers, trade names, and national use of mercury pesticides are tabulated. It is recommended that mercury tolerances and concentration in water, air, and food be given thorough study. (Knapp-USGS)
W70-03456

USE OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL STUDIES,
Northeastern Univ., Boston, Mass. Dept. of Civil Engineering.
Alvin S. Goodman, and Richard J. Tucker.
Available from the Clearinghouse as PB-189 293, $3.00 in paper copy, $0.65 in microfiche. Federal Water Pollution Control Administration Research Series Report No ORD-6, July 1969. 121 p, 17 fig, 10 tab, 71 ref, 4 append. FWPCA Grant No WP-01090, FWPCA Program No 16090.

Descriptors: *Water quality, *Water pollution control, *Mathematical models, Computer programs, Dissolved oxygen, Biochemical oxygen demand, Waste water treatment, Waste dilution, Statistical methods.
Identifiers: *Sensitivity analysis.

Mathematical models were utilized to study water pollution control programs in a river basin. Sensitivity analyses, with a steady state model, showed substantial variation of cost for sewage treatment, depending upon stream purification parameter selections. When actual parameters are less favorable than design values, quality standards may not be met. An unsteady state model was developed to trace a time profile at any specified station in terms of flow and quality as BOD, dissolved oxygen, coliforms, and chlorides while upstream discharge, water temperature, and solar radiation vary. A new empirical procedure was developed to route unsteady stream flow. The time varying model was used to investigate the effectiveness of treatment when the stream's assimilative capacity varies with distance and time. DO values are worse at times than the steady state value, and susceptibility to poorer conditions increases with higher BOD releases. (Knapp-USGS)
W70-03488

CHEMICAL AND DETRITAL FEATURES OF PALOUSE RIVER, IDAHO, RUNOFF FLOWAGE,
Eastern New Mexico Univ., Portales. Dept. of Biological Sciences.
Philip A. Buscemi.
Oikos, Vol 20, No 1, p 119-127, 1969. 3 fig, 3 tab, 30 ref.

Descriptors: *Runoff, *Groundwater, *Seston, *Sediments, Organic matter, Currents (Water), Water pollution sources, Surface runoff, Rainfall, Snowmelt, Surface waters, Streams, Hydrogen ion concentration, Iron, Magnesium, Nitrates, Phosphates, Algae, Detritus, Pulp wastes, Livestock, Idaho.
Identifiers: Tree bark, Charcoal, Algal growth, Stream concourse, Palouse River (Idaho)

Water and sediment samples were collected at four stations established on Palouse River, Idaho. Determinations included pH, nitrate, phosphate, iron, manganese, hardness, suspended detritus (drifting seston), and organic content of sedimentary deposits. The results show influence of rainfall, melt water, stream inflow, and mill pond on seston concentration. Variation in chemical composition of water indicated the effect of either melt water runoff or subterranean discharge. The increased pollution of water and sediment enrichment in organic matter were correlated with locations of lumber camps and cattle grazing. (Wilde-Wisconsin)
W70-03501

DISSOLVED ORGANIC MATTER IN AN ANOXIC FJORD, WITH SPECIAL REFERENCE TO THE PRESENCE OF MERCAPTANS,
Dalhousie Univ., Halifax (Nova Scotia). Inst. of Oceanography; and Washington Univ., Seattle. Dept. of Oceanography.
Donald D. Adams, and Francis A. Richards.
Deep-Sea Research, Vol 15, p 471-481, 1968. 3 fig, 6 tab, 27 ref.

Descriptors: *Organic matter, *Oxygenation, Anaerobic bacteria, Sea water, Test procedures, Separation techniques.
Identifiers: *Lake Nitinat (Vancouver Island), Anoxic waters, Mercaptans, Dissolved organic matter, Polar constituents, Solvent extraction, Thin-layer chromotography, Oxidation potential, Organic carbon, Desulfovibrio desulfuricans.

From 40 to 60% of dissolved organic carbon was recovered from acidified sea water by extraction with petroleum ether and ethyl acetate. Oxygen-bearing waters yielded 1.0-1.2 milligram/liter of dissolved organic matter whereas deoxygenated waters yielded 1.8-1.9 milligram/liter. Increase in the content of organic matter was accompanied by the presence of nonpolar and polar nonvolatile mercaptans. Tentatively identified sterols or sterol esters, choline-containing lipids, and ninhydrin-positive compounds were found in both oxygenated and anaerobic waters. Observations may have bearing upon the distribution of higher forms of life. (Wilde-Wisconsin)
W70-03503

THE MAGNETIC SPHERULES IN SEDIMENTS OF LAKE MENDOTA, WISCONSIN,
Toronto Univ. (Ontario). Dept. of Geology; and Wisconsin Univ., Madison. Dept. of Geology and Geophysics.
Jerome O. Nriagu, and Carl J. Bowser.
Water Research, Vol 3, p 833-842, 1969. 4 fig, 5 tab, 12 ref.

Descriptors: *Pollutant identification, *Water pollution, *Lakes, Lake soils, Sedimentation, Diagenesis, Sediments.
Identifiers: *Lake Mendota (Wis), INA method, Magnetic microspherules, Lake muds, Sedimentation pattern.

Analyses of magnetic microspheric particles from the bottom mud of Lake Mendota, Wisconsin, suggest that these intrusions are by-products of either industrial or domestic activity. Washing the atmosphere, influent of streams, and urban runoff are possible channels of transportation. The profile distribution of these resistant spherules eliminates their extraterrestrial origin and documents the progressive pollution of the lake by man. (Wilde-Wisconsin)
W70-03504

PARTICULATE FRACTIONS IN WATER AND THE RELATIONSHIP TO AQUATIC MICROFLORA,
Ohio State Univ., Columbus. Dept. of Microbiology; and Ohio State Univ., Columbus. Aquatic Biology Lab.
Robert M. Pfister, Patrick R. Dugan, and James I. Frea.
International Association of Great Lakes Research, Proceedings 11th Conference Great Lakes Research, p 111-116, 1968. 6 fig, 2 tab, 11 ref.

Descriptors: Aquatic environment, Water quality control, Ecosystems, Biological communities, Detritus, Chemical properties, Interfaces, Adsorption, Electron microscopy, Biocontrol.
Identifiers: *Lake Erie, *Particulate fractions, *Microflora, Linear sucrose gradient, Beckman tube cutting device, Membranous organelles, Streptomyces, Micromonospora, Pseudomonads, Environmental contaminants, Biological reactions

Water samples from a 15-foot depth of Lake Erie and from the surface of Sandusky River, Ohio, were subjected to gradient centrifuging. Different submicroscopic fractions of suspended particulates (mineral and detritus) were investigated by electron microscopy and examined for their ability to influence biological reactions. Addition of the particulate fraction 0.3 micron and larger to a carbon-free salts medium caused a significant increase in the biomass of Micromonospora and Streptomyces. An aggregation of submicroscopic particles of magnesium silicate with an exocellular polymer, produced by a floc-forming pseudomonad, was demonstrated. A system of ecological control of pollution involving a buildup of larger aggregates by association of inorganic particles and organisms is postulated. (Wilde-Wisconsin)
W70-03505

HEATED WATER FLOW FROM CHANNELS INTO IMPOUNDMENTS,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
H. Stefan, and F. R. Schiebe.
ASCE National Water Resources Engr Meeting, Memphis, Tenn, Jan 26-30, 1970. Preprint, 39 p, 19 fig.

Descriptors: *Heated water, *Heat flow, *Impoundments, Lakes, Reservoirs, *Thermal pollution, Hydraulic models, Density currents, Stratified flow, Turbulence, Jets, Temperatures, Froude number, Thermal stratification.

The physical aspects of the flow of heated water from open channels into large, deep impoundments, such as lakes and reservoirs, are considered. The data were obtained in a number of laboratory experiments. Both the outlet channel and the receiving tank had rectangular cross-sections, but the tank was more than ten times wider and deeper than the channel. Measurement of local velocities proved to be difficult, and the tethered sphere was developed. Local temperatures were also measured and surface spreading patterns were recorded photographically. Densimetric Froude numbers and Reynolds numbers at the outlet ranged from 0.6 to 7.2 and from 1500 to 9600, respectively. Some results were presented graphically, but analysis was minimal. (Novotny-Vanderbilt)
W70-03540

THERMAL-HYDRAULIC STUDY - ARKANSAS COOLING RESERVOIR,
Bechtel Corp., San Francisco, Calif.
For primary bibliographic entry see Field 05D.
W70-03542

USE OF RIVER MODELS IN COOLING CIRCULATING WATER STUDIES,
Worcester Polytechnic Inst., Mass.
Leslie Hooper, and Lawrence Neale.
Journal Boston Society of Civil Engineering, Vol 44-45, p 356-365, 1957-1958.

Descriptors: *Model studies, *Hydraulic models, *Water cooling, Heat transfer, Temperature, Thermal powerplants.

Model tests are used to outline the nature of the difficulties involved when a relatively small river is called upon to supply the cooling water for a modern steam unit and to suggest any means of reducing the effects both upon the unit performance and the river. Considerations in the design of a model to study the density and temperature effects of the cooling water problem in a stream has been made. Reynolds number, distortion, density effects, temperature and heat transfer have been analyzed. The translation of the tem-

perature rise and heat transfer effects from the model to the prototype and the question whether any of the cold water that is being provided upstream in the river manages to get by the plant without bearing its full load of heat has been treated. Conclusions were: (a) The recommendations in the design of cooling water systems is that the plant should be located on the outside bank of a stream. (b) It is believed that a river model can be used to provide design information on the temperature increase that can be expected for various flow conditions in the river and circulating water demands of a steam powerplant. (Guerrero-Vanderbilt)
W70-03549

5C. Effects of Pollution

SOME WATER QUALITY ASPECTS OF THE UPPER ROANOKE RIVER BASIN WITH SPECIAL EMPHASIS ON TEMPERATURE,
Virginia Polytechnic Inst., Blacksburg. Water Resources Research Center.
Kenneth B. Cumming, and R. Don Estes.
Partly supported by Bur of Sport Fisheries and Wildlife. Available from the Clearinghouse as PB-189 170, $3.00 in paper copy, $0.65 in microfiche. Water Resources Research Center Bulletin 23, Virginia Polytechnic Institute, Sept 1969. 66 p, 16 fig, 3 tab, 17 ref, 11 append. OWRR Project No A-012-VA.

Descriptors: *Pumped storage, *Water temperature, *Thermal pollution, *Virginia, Stratification, Forebays, Water pollution control, Eutrophication, Environment, Aquatic habitats, Striped bass, Fisheries, Water quality, Water management (Applied), Regulation.
Identifiers: Roanoke River (Va).

A study was undertaken by the Virginia Cooperative Fishery Unit on the effects of the Smith Mountain pumped storage project. The study documents some of the before and after water quality features of the Roanoke River in the area of the pumped storage operation. Until now, there has been only a limited amount of data and little evaluation of the effects of such projects upon downstream water quality. While emphasis has been placed on water temperature regimes above, in, and below the project, there is considerable information on water chemistry and some of the operating dynamics which affect water quality. The research is of particular interest because downstream water quality could affect the resident striped bass population of Kerr Reservoir. There appears to be a trend toward deepening of the summer epilimnion since 1965. The schedule of water releases has substantially changed the flow pattern in the river without altering the average volume of discharged water. This variable flow has led to variable temperatures on a weekly basis and there is inferred a variable water chemistry because of the low flow during weekends. Temperature profiles are plotted and the data used to construct them are tabulated. (Knapp-USGS)
W70-03244

FISH AND POWER PLANTS,
New York State Dept. of Conservation, Albany. Div. of Marine and Coastal Resources.
Albert C. Jensen.
The Conservationist, New York State Conservation Department, Vol 24, No 3, p 2-5, Dec 1969-Jan 1970. 4 p, 2 fig, 2 photo.

Descriptors: *Hudson River, *Estuarine environment, *Pumped storage, Hydroelectric plants, Water temperature, Fish, Ecology, Aquatic habitats, Environmental effects, Fisheries, New York.
Identifiers: Hudson River Estuary, Storm King Mountain, Cornwall (NY).

A biological survey was made to predict the effects of the proposed Storm King Mountain pumped storage hydroelectric plant on the ecology of the Hudson River Estuary. Large numbers of eggs, larvae, and young striped bass would be withdrawn by the proposed hydroelectric plant. However, the eggs and young fish that would be withdrawn would be but a small percentage of the total number of each of the life stages of striped bass present in the estuary. Approximately 2.8% would be subject to withdrawal. Substantial numbers of blueback herring, alewife, tomcod and white perch, small enough to pass through the screens, also would be withdrawn seasonally but that because of the varying distribution of the species in the estuary, the effect of losses by the operation of the plant probably would be minimal. Operation of additional plants--power, manufacturing or other--that require large volumes of water could, in combination with the proposed Cornwall plant, destroy sufficient numbers of eggs and larvae of fishes to adversely affect subsequent populations. These effects could be particularly severe if the plants were built in areas of heavy fish concentrations. The proposed pump-storage hydroelectric plant at Cornwall would not have a significant adverse effect on the populations of striped bass and shad in the Hudson River. (Knapp-USGS)
W70-03250

STUDIES RELATING TO WATER MINERALIZATION AND HEALTH,
Bureau of Water Hygiene, Cincinnati, Ohio.
Elliott F. Winton, and Leland J. McCabe.
Journal of American Water Works Association, Vol 62, No 1, p 26-30, Jan 1970. 5 p, 2 fig, 4 tab, 36 ref.

Descriptors: *Water quality, *Public health, *Human diseases, *Human pathology, *Hardness (Water), Mortality, Trace elements, Calcium, Magnesium, Chemical properties, Water softening.
Identifiers: Heart disease-water quality relations.

Recent studies on the relation of heart disease to water quality are reviewed. Correlation is sufficient to suggest more definitive studies to resolve the question. Calcium, magnesium, and total hardness contents of drinking water seem to be inversely correlated with coronary heart disease death rates in England, the United States, and Asian countries. Several specific questions are listed for experimental and statistical investigation. (Knapp-USGS)
W70-03252

A RECONNAISSANCE OF THE QUALITY OF WATER IN LAKE DICIE AND WEST CROOKED LAKE NEAR EUSTIS, FLORIDA,
Geological Survey, Tallahassee, Fla.
Darwin Knochenmus.
Geol Surv Open-file Report, Sept 1969. 10 p, 1 fig, 1 tab.

Descriptors: *Water quality, *Lakes, *Eutrophication, *Florida, Aquatic productivity, Water pollution sources, Septic tanks, Storm drains, Nutrients, Urbanization, Storm runoff.
Identifiers: Eustis (Fla), Crooked Lake, Lake Dicie.

A study was made of 2 lakes near Eustis, Florida to determine the cause of algal blooms in one of them while the other had no blooms. Lake Dicie is smaller, shallower, and thus at times probably warmer than West Crooked Lake. Significant land use differences in their drainage basins exist; private dwellings serviced by septic tanks comprise 50% of the drainage area of Lake Dicie as compared to only 20% of the drainage area of West Crooked Lake. The ratio of drainage area to lake surface is approximately 24:1 for Lake Dicie (after installation of a storm drain) whereas the ratio is only 10:1 for West Crooked Lake. The higher concentration of nutrients in Lake Dicie seems to be related to the larger drainage area ratio and the increase in nutrient and water inflow through the storm drain, as well as to the many septic tanks in the Lake Dicie drainage basin. Many other small lakes and ponds in Lake County which receive street drainage have algal blooms. (Knapp-USGS)
W70-03260

ALGAL GROWTH AND PRIMARY PRODUCTIVITY IN A THERMAL STREAM,
Washington Univ., Seattle. Dept. of Zoology.
John G. Stockner.
Journal Fisheries Research Board of Canada, Vol 25, No 10, p 2037-2058, 1968. 13 fig, 7 tab, 25 ref.

Descriptors: *Primary productivity, *Algae, *Thermal water, Periphyton, Biomass, Physiological ecology, Cyanophyta, Diffusion, Respiration, Phosphates, Ecosystems, Organic matter, Water pollution, Thermal pollution, Streams, Nutrients, Light, Washington, Water chemistry, Oxygen, Hydrogen ion concentration, Photosynthesis, Alkalinity, Nitrates, Conductivity, Chlorides, Carbonates, Sulfates, Bicarbonates, Potassium, Iron, Sodium, Calcium, Magnesium, Phosphorus.
Identifiers: *Algal growth, *Thermobiology, *Diurnal oxygen curves, Calorimetry, Solarimetry, Yellowstone National Park, Mt Lassen National Park, Mt Rainier National Park, Ohanapecosh Hot Springs (Wash), Schizothrix, Phormidium, Winkler technique, Oxygen electrodes, Atomic absorption spectrophotometry, Total dissolved solids, Hedriodiscus, Caloparyphus.

Trophic relationships in flowing water are not as well understood as those in more static environments. Because of their relatively constant conditions, streams draining thermal springs are ideal sites for such studies. Estimates of primary production and respiration of blue-green algae in stream draining one of the Ohanapecosh Hot Springs, Washington, were obtained throughout 1966 from daily oxygen curves. Rates of gross primary productivity were slightly higher than published values from other aquatic ecosystems, but were less than recent estimates, derived from measurement of radiocarbon uptake from other thermal waters. Calculated ratios, production/respiration, were in range 1.1-5.0. As growing season progressed, photosynthetic effects on ionic composition of effluent water, as well as morphological changes in algal mat, were observable. Changes in algal biomass during 1964-1965, together with growth rates in denuded areas by two methods of harvest were studied. Accelerated growth occurred in May and June, associated with maximal values for primary production, whereas growth was minimal in winter. Significant differences in growth between years were attributed to differences in harvesting methods, and to production of auto-inhibitory toxins by senescent cells in mature mat. Annual energy budget for mat is derived from 1966 estimates. (Eichhorn-Wisconsin)
W70-03309

CONTROL OF BLUE-GREEN ALGAE BLOOMS WITH 2,3-DICHLORONAPHTHOQUINONE,
Wisconsin Univ., Madison. Dept. of Botany.
For primary bibliographic entry see Field 05G.
W70-03310

A STUDY OF THE OPEN WATER DISTRIBUTION AND ABUNDANCE OF NET PLANKTON AS AN INDEX OF EUTROPHICATION IN LAKE SUPERIOR,
Minnesota Univ., Minneapolis. School of Public Health.
For primary bibliographic entry see Field 02H.
W70-03311

MICROBIOLOGY OF SEWAGE LAGOONS-EFFECTS OF INDUSTRIAL WASTES ON LAGOON ECOLOGY,
North Dakota Univ., Grand Forks. School of Medicine.
John W. Vennes.
Available from the Clearinghouse as PB-189 159, $3.00 in paper copy $0.65 in microfiche. Completion Report, Aug 1969. 82 p, 3 fig, 41 tab, 35 ref. OWRR Project No A-016-NDAK.

Descriptors: *Microbiology, *Sewage lagoons, *Industrial wastes, Sewage treatment, North Dakota, Coliforms, Oxidation lagoons, Biochemical oxygen demand, Photosynthesis, Hydrogen sulfide, Lakes, Algae, Enteric bacteria, Methane bacteria, Chemical analysis, Water pollution, Chlorella, Scenedesmus.
Identifiers: *Microbial ecology, Purple sulfur bacteria, Population equivalents (Wastes), Red River Valley (North Dakota), Sulfate reduction, Potato processing wastes, Cheese manufacturing wastes, Starch manufacturing wastes, Water quality standards, Grafton (ND), Lakota (ND), Harvey (ND), Chromatium vinosum, Thiocapsa floridana, Enterococci, Park River (ND), Sheyenne River (ND), Thiopedia.

State and federal legislation, regulating effluent discharge to natural waters, is such that food processing industries in North Dakota must discharge wastes into municipal lagoons resulting in frequent overloads of these systems. Lagoon at Grafton, designed for 5-day biochemical oxygen demand (BOD-5) of 30 pounds/acre per day, receives 240, largely from two potato processing plants. Increased loadings favor (as dominant microorganisms in these lagoons) the purple sulfur bacteria (PSB), which photosynthetically utilize hydrogen sulfide and various volatile organic acids for growth. Most reduction in BOD-5 at Grafton is attributable to three genera of PSB: Chromatium, Thiopedia, Thiocapsa. Increased loading does not significantly multiply numbers of enteric organisms here. A natural lake, used for sewage stabilization in Lakota, receives whey; it recovers to an algal phase during summer, and shows no increase in numbers of enteric organisms. At Harvey, an aerated continuous discharge lagoon, receiving domestic wastes and intermittent creamery wastes, reduces BOD-5 to near stream levels, but cannot reduce coliforms to acceptable numbers. If the latter treatment is to succeed in northern climates, consideration must be given to longer detention times, greater delivery of oxygen to cells, chlorination, or reevaluation of stream standards. (Eichhorn-Wisconsin)
W70-03312

EFFECTS OF ENDRIN ON BLOOD AND TISSUE CHEMISTRY OF A MARINE FISH,
Bureau of Sport Fisheries and Wildlife, Highlands, N.J. Sandy Hook Marine Lab.
Ronald Eisler, and Philip H. Edmunds.
Transactions of the American Fisheries Society, Vol 95, No 2, p 153-159, Apri 1966. 4 fig, 5 tab, 28 ref.

Descriptors: *Chemistry, *Marine fish, *Endrin, Insecticides, Temperature, Salinity, Hydrogen ion concentration, Mortality, Colorimetry, Spectroscopy, Sodium, Potassium, Calcium, Chlorides, Ureas, Magnesium, New Jersey, Weight, Length, Eels, Killifishes, Mullets, Silversides, Guts, Proteins.
Identifiers: *Blood, *Tissue, Puffers, Sphaeroides maculatus, Hemoglobin, Liver, Serum, Chloresterol, Gamma-globulin, Zinc, Gill tissue, Sandy Hook Bay (NJ), Anguilla rostrata, Fundulus heteroclitus, Fundulus majalis, Pomatomus saltatrix, Pseudopleuronectes americanus, Mugil cephalus, Syngnathus fuscus, Oral membrane, Kidneys, Menidia menidia.

Adult northern puffers, Sphaeroides maculatus, were exposed to graded concentrations of endrin, a chlorinated hydrocarbon insecticide, at 20C, 24 parts/thousand salinity and pH 8.0. All animals subjected to 10.0 parts per billion (ppb) of endrin died within 24 hours. At concentrations of 1.0 ppb of endrin, or lower, no mortality occurred within 96 hours. Blood and tissue samples from fish surviving the 96-hour exposure were analyzed by photoelectric colorimetry and atomic absorption spectroscopy. Mean hemoglobin content and relative liver size of puffers exposed to endrin concentrations of 1.0, 0.5, 0.1, or 0.05 ppb did not significantly differ from controls. Although no meaningful changes in serum chloride levels, gamma globulin, and uric acid were found, concentrations of sodium, potassium, calcium, and chloresterol in serum were consistently higher in experimental animals than controls. Concentrations of sodium, potassium, calcium, magnesium, and zinc in livers of test animals were consistently lower. Concentrations of same cations in gill tissue fluctuated widely. Exposure to sublethal concentrations of endrin impaired liver functions, evidenced by transfer of major cations from hepatic tissue into serum and by elevated serum cholesterol. (Jones-Wisconsin)
W70-03314

COMPONENTS OF THE BOTTOM FAUNA OF THE ST LAWRENCE, GREAT LAKES,
Toronto Univ (Ontario). Dept. of Zoology; and Fisheries Research Board of Canada, Winnipeg (Manitoba).
For primary bibliographic entry see Field 02H.
W70-03315

LIMNOLOGICAL STUDIES OF LAKE NORRVIKEN, A EUTROPHICATED SWEDISH LAKE. I. WATER CHEMISTRY AND NUTRIENT BUDGET,
Uppsala Univ. (Sweden). Inst. of Limnology.
For primary bibliographic entry see Field 02H.
W70-03322

A LABORATORY METHOD FOR THE STUDY OF MARINE BENTHIC DIATOMS,
Oregon State Univ., Corvallis. Dept. of Botany.
C. David McIntire, and Barry L. Wulff.
Limnology and Oceanography, Vol 14, No 5, p 667-678, 1969. 6 fig, 4 tab, 20 ref.

Descriptors: *Marine algae, *Diatoms, *Benthic flora, Light intensity, Biomass, Distribution, Ecosystems, Population, Oregon, Intertidal areas, Physiological ecology, Littoral, Estuaries, Photosynthesis, Respiration, Pigments, Chlorophyll, Temperature, Oxygen, Salinity.
Identifiers: Desiccation, Yaquina Bay (Ore), Carotenoids, Species, Diversity index, Achnanthes, Actinoptychus, Amphipleura rutilans, Amphora, Aulacodiscus, Bacillaria, Biddulphia, Chaetoceros, Cocconeis, Coscinodiscus, Dimerogramma, Diploneis, Eunotogramma, Fragilaria, Gomphonema, Gyrosigma, Melosira, Navicula, Nitzschia, Skeletonema, Plagiogramma, Pleurosigma, Rhaphoneis, Rhoicosphenia, Surirella, Synedra.

Effects of light intensity and exposure to desiccation on vertical distribution and growth of marine benthic diatom populations were investigated in a laboratory model ecosystem and respirometer chamber. Diatom flora developed was similar to that from field stations in lower Yaquina Bay, Oregon. Vertical distribution of many species was closely related to light intensity and period of exposure to desiccation. Biomass accumulated rapidly on substrates subjected to high light intensities without exposure to desiccation. Communities acclimated to various light intensities and period of desiccation responded differently to changes in light intensity in respirometer chamber. Experimental results show that laboratory apparatus described can be useful in study of simplified intertidal communities. System provides some laboratory control over salinity, light intensity, tidal cycle, and probably temperature. Movements and grazing activities of small marine invertebrates could be studied. It is emphasized that use of such laboratory ecosystems is subject to certain limitations resulting from simplifications of nature. Laboratory ecosystems are best used to gain information to supplement and help understand concurrent observations in the field. (Jones-Wisconsin)
W70-03325

TISSUE CHANGES IN PUFFERS EXPOSED TO METHOXYCHLOR AND METHYL PARATHION,
Bureau of Sport Fisheries and Wildlife, Highlands, N.J. Sandy Hook Marine Lab.
Ronald Eisler.
Bureau of Sport Fisheries and Wildlife, Wash, DC. Technical Paper 17, Sept 1967. 15 p, 6 fig, 6 tab, 37 ref.

Descriptors: *Insecticides, *Marine fish, Mortality, Sodium, Potassium, Calcium, Magnesium, Iron, Enzymes, Estuarine environment, NJ, Temperature, Spectrophotometry, Gonads, Length, Weight, Proteins, Electrophoresis, Salinity, Hydrogen ion concentration, Crustaceans.
Identifiers: *Tissue changes, *Puffers, *Methoxychlor, *Methyl parathion, Blood, Serum, Zinc, Liver, Gills, Biocides, Sandy Hook Bay (New Jersey), Muscle, Gill arch, Densitometric, Starvation, Biochemical profiles, Hemoglobin, Hematocrit, Erythrocyte.

Puffers were exposed to either 30 parts per billion (ppb) methoxychlor, 20,200 ppb methyl parathion, or a combination of 15 ppb of methoxychlor and 10,100 ppb of methyl parathion. These concentrations produced approximately 5% mortality in 96 hours under experimental conditions. Tissues from each group were analyzed for blood and serum constituents and for sodium, potassium, calcium, magnesium, zinc, and iron. Puffers in 30 ppb methoxychlor remained active as controls, ate readily, and experienced no significant mortality. No statistically significant differences at 0.01 level were observed between methoxychlor-exposed puffers and controls for parameters investigated. Groups exposed to methyl parathion alone, or to methyl parathion in combination with methoxychlor, refused to eat, were sluggish, and after 96 hours, exhibited a rapid increase in mortality. Survivors, compared to controls, had less hemoglobin, erythrocytes, lower hematocrit, inhibition of serum esterase enzymes, less magnesium in liver, and less zinc in liver and gill filament; differences were significant at 0.01 level. Profiles were based on effects of each insecticide on blood and tissues. Visual patterns provided by profiles suggest means of identifying unfavorable environmental conditions before appearance of obvious morphological or physiological changes. (Jones-Wisconsin)
W70-03326

LABORATORY STUDIES OF PERIPHYTON PRODUCTION AND COMMUNITY METABOLISM IN LOTIC ENVIRONMENTS,
Oregon State Univ., Corvallis. Pacific Cooperative Water Pollution and Fisheries Research Labs.
C. David McIntire, and Harry K. Phinney.
Ecological Monographs, Vol 35, No 3, p 237-258, Summer 1965. 15 fig, 12 tab, 54 ref.

Descriptors: *Periphyton, *Productivity, *Metabolism, *Lotic environment, Ecosystems, Primary productivity, Energy, Respiration, Light intensity, Temperature, Carbon dioxide, Seasonal, Biomass, Organic matter, Chlorophyll, Export, Dissolved oxygen, Photosynthesis, Hydrogen ion concentration, Bicarbonates, Alkalinity, Diatoms, Cyanophyta, Chlorophyta, Molecular structure, Chemical analysis, Oxygen, Turbidity, Copepods, Oligochaetes, Natural streams, Dissolved solids.
Identifiers: Community, Carotenoids, Total solids, Particulate, Phormidium retzii, Synedra ulna, Oedognium, Light-adapted, Shade-adapted, Ulothrix, Melosira varians, Cymbella, Epithemia, Navicula, Anabaena, Tendipes, Calopsectra, Polypedilum, Brilla, Baetis, Callibaetis, Paraleptophlebia, Ameletus, Cinygmula, Epeorus, Compensation point.

Studies of periphyton production and community metabolism in lotic environments were made in laboratory streams and with a photosynthesis-respiration chamber. Curves related illumination intensity to primary production in 'light-adapted' and 'shade-adapted' periphyton communities. In the former, primary production was continuously enhanced at illumination intensities exceeding 1000-foot-candles by increasing molecular carbon dioxide supply to a concentration of 45 milligrams/liter; no significant enhancement occurred in shade-adapted community. Gross production in laboratory streams was slightly greater than normally reported for eutrophic lakes and oceanic

waters and more characteristic of the least-productive flowing water systems, within the value range for natural environments at similar periods. Efficiency of fixation of usable light energy as organic matter was 15.1% in the light-grown community and 18.3% in the shade-grown. Laboratory community efficiencies were higher than estimated for most natural ecosystems. Chlorophyll a content was well within the range of values reported for several types of natural communities. Laboratory gross primary production-chlorophyll a ratios varied from 0.2 to 1.4 milligrams oxygen/hour per milligram chlorophyll a. The community, under higher light intensity, was reasonably stable by end of third month; shadegrown community succession was slower. (Jones-Wisconsin)
W70-03327

CHIRONOMIDA AND THE STUDY OF LAKE TYPES,
For primary bibliographic entry see Field 02H.
W70-03332

ECOLOGY OF CHIRONOMIDAE, CHAOBORIDAE, AND OTHER BENTHOS IN FOURTEEN WISCONSIN LAKES,
Wisconsin Univ., Madison. Dept. of Entomology.
For primary bibliographic entry see Field 02H.
W70-03333

ENVIRONMENTAL AND NUTRITIONAL REQUIREMENTS FOR ALGAE,
Scripps Institution of Oceanography, La Jolla, Calif.
Osmund Holm-Hansen.
Proceedings of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ, Berkeley, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Ore, Pac Northwest Water Lab, p 98-108. 37 ref.

Descriptors: *Algae, *Nutrient requirements, *Environmental effects, Biomass, Phytoplankton, Zooplankton, Red tide, Vitamins, Carbon, Hydrogen, Oxygen, Nitrogen, Sulfur, Phosphorus, Potassium, Magnesium, Calcium, Iron, Boron, Copper, Molybdenum, Cobalt, Manganese, Sodium, Chlorine, Productivity, Eutrophication, Photosynthesis, Time, Dissolved solids, Cyanophyceae, Sewage effluents, Ions, Chemical properties, Enzymes, Light intensity, Temperature, Carbohydrates, Lipids, Diatoms, Oceans, Physiological ecology.
Identifiers: Ciliate, Photoautotrophic, Endosymbiotic, Growth factors, Vanadium, Macronutrient, Micronutrient, Zinc, Silicon, Bromide, Iodine, Adenosine triphosphate, Selenastrum, Particulate fraction, Algal strains, Euphotic zone, Morphology, Cytology.

Adenosine triphosphate, in a sensitive analytical method, is useful in estimating total biomass. Essential macronutrient elements are: carbon, hydrogen, oxygen, nitrogen, sulfur, phosphorus, potassium, magnesium, and calcium. Essential micronutrient elements are: iron, boron, zinc, copper, molybdenum, manganese, cobalt, sodium, and chlorine. Many diatoms need silicon for growth; whether vanadium, bromine, and iodine are sometimes essential is unknown. The only known organic nutrients important for various algae, are vitamins B-1, B-12, and biotin. In productivity studies of natural waters and eutrophication, the potential capacity of water to support phytoplankton should be known; also which element (s) is limiting to algal growth. Data from enrichment experiments are analyzed. Bottle tests with selected algal strains indicate by productivity, carrying capacity of water. This 'growth potential' serves as a guideline in eutrophication problems and sewage treatment. Physiological adaptation of species to environment is significant; nutrient deficiency is expected to alter cell chemical composition or enzymatic activity, or concentration. Open-system chemostat techniques make possible determination of substrate concentration permitting maximum growth and prediction of productive capacity of species for different water masses. Heterotrophy, or uptake of organic solutes by plant cells, is significant. (See Vol. 3, No. 7, Field 5C, W70-02775). (Jones-Wisconsin)
W70-03335

PHYSIOLOGICAL AND REGULATORY ASPECTS OF HETEROTROPHY IN ALGAL FLAGELLATES: CONDITIONALLY EXPRESSED CHARACTERISTICS,
California State Coll., Hayward. Dept. of Biological and Health Sciences.
Stanley Scher.
Proceedings of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ, Berkely, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Ore, Pac Northwest Water Lab, p 117-140. 4 fig, 9 tab, 85 ref.

Descriptors: *Physiological ecology, *Algae, *Biological properties, Organic compounds, Nutrition, Photosynthesis, Environmental effects, Metabolism, Enzymes, Cytological studies, Eutrophication, Chlamydomonas, Dinoflagellates, Ochromonas, Carbohydrates, Amino acids, Hydrogen ion concentration, Chelation, Inhibition, Carbon radioisotopes, Water pollution effects, Vitamins.
Identifiers: *Heterotrophy, *Flagellates, *Regulatory biology, Thermobiology, Photobiology, Cytochemistry, Algal growth, Carbon sources, Nitrogen sources, Buffers, Biosynthesis, Metabolites, Euglena gracilis, Eucaryotes, Chlamydobotrys, Photoautotrophy, Dissolved organic matter, Phosphorus sources, Analog compounds, Radiocarbon uptake technique, Repression, Chloroplasts, Cellular organelles, Mitochondria, Auxotrophy.

Evidence mounts of utilization, by photoautotrophic algae for growth, of various exogenous organic compounds of low molecular weight dissolved in the hydrosphere. Such heterotrophy may take various forms: organic compounds may serve as intracellular carbon, nitrogen, and phosphorus sources; as hydrogen donors for carbon dioxide fixation or nitrite reduction; or as buffers and chelators. Utilizable carbon and nitrogen sources probably serve to control cellular growth and reproduction by repression of the synthesis of inducible enzymes, or by feedback inhibition of enzymes operating in biosynthetic pathways. Recent evidence suggests that such controls may operate directly on algal chloroplasts and mitochondria. Because heterotrophy may be influenced by environmental characteristics, such as non-optimal pH or supraoptimal temperature, it has been termed latent or conditionally-expressed auxotrophy. Information on heterotrophy is illustrated with evidence accumulated from study of various strains of the green alga, Euglena. Large and varied fractions of dissolved organic matter found in eutrophic waters suggest that heterotrophic phenomena may be important. Changes away from optimal conditions may limit population growth of eucaryotes via emergence of auxotrophy or failure of photosynthetic mechanisms, or community structure may be changed because of competition of algae with heterotrophic bacteria. (See Vol 3, No 7, Field 5C, W70-02775). (Eichhorn-Wisconsin)
W70-03336

LAKE MICHIGAN BEACH SURVEY 1968.
Illinois State Sanitary Water Board, Springfield.

Illinois State Sanitary Water Board, Report to 76th General Assembly, Feb 1969. 40 p, 3 ref, 7 tab, 18 fig.

Descriptors: *Water quality, *Lake Michigan, *Illinois, *Water pollution, *Beaches, Recreational facilities, Bacteria, Coliforms, Water pollution sources, Phosphates, Surfactants, Ammonia, Hydrogen ion concentration, Phenols, Thermal pollution.
Identifiers: Lake County, Cook County, Waukegan (Ill), Chicago.

The 1968 Sanitary Water Board monitoring program indicated that portions of Lake Michigan inshore waters failed in many cases to meet water quality criteria. Shore water on Illinois beaches frequently failed to meet bacteria criteria. Unacceptably high bacterial counts were typical of Lake County beaches and Cook County beaches near major recreational boat harbors. All beaches failed to meet criteria for phosphates and surfactants (MBAS). Concentrations of ammonia nitrogen increases in a northerly direction. Two-thirds of Lake County beaches failed to meet ammonia criteria while only two of nineteen failed to meet the criteria in Cook County. All beaches met the requirements for temperature, phenol-like substances, cyanides (with one sample exception) and pH (also with a single sample exception). The discharge of polluted water into Lake Michigan from the Chicago area, as the result of a severe rainstorm on 16 August 1968, did not significantly lower the bacterial quality of the Chicago beaches, with the exception of a two-day effect on beaches near the mouths of the Chicago and Calumet rivers. The beaches of the lowest quality were those in Lake County. This was largely a result of the overloaded Waukegan sewage treatment plant, the industrial waste effluent discharges, and the effluent from the five small primary sewage treatment plants operated by the North Shore Sanitary District. (Davis-Chicago)
W70-03339

CLEANING OIL CONTAMINATED BEACHES WITH CHEMICALS, A STUDY OF THE EFFECTS OF CLEANING OIL CONTAMINATED BEACHES WITH CHEMICAL DISPERSANTS.
Federal Water Pollution Control Administration, Edison, N.J. Northeast Region Research and Development Program.

Available from the Clearinghouse as PB-189 172, $3.00 in paper copy, $0.65 in microfiche. FWPCA Water Pollution Control Research Series, DAST-27, Aug 1969. 22 p, 3 tab, 19 fig, 7 ref. FWPCA Program 15080 FHS 08/69.

Descriptors: Beach, *Cleaning, Detergent, *Emulsifier, Erosion, Oil, *Oil wastes, Water pollution, Quicksand, Sand.

Oil-dispersing chemicals were treated for cleaning persistent-type crude oil from experimentally contaminated New Jersy coastal beaches and were found to be generally ineffective. Although they completely cleaned the surface of the oiled sand, they removed little of the total oil. Instead they caused the oil to penetrate more deeply into the underlying sand, thereby compounding the pollution problem by expanding the zone of pollution, complicating any subsequent mechanical removal and, possibly, causing the oil to persist longer. Chemical treatment failed to induce 'quicksand' or cause perceptible erosion of beach sand. A decrease in the 'cohesiveness' of the sand was observed, but this also occurred in the presence of oil alone and could not be attributed to the presence of chemical.
W70-03349

BIOLOGICAL N2 FIXATION IN LAKES,
Wisconsin Univ., Madison. Water Resources Center.
Robert H. Burris.
Available from the Clearinghouse as PB-189 163, $3.00 in paper copy, $0.65 in microfiche. Wisconsin Water Resources Center, Technical Report OWRR B-020-Wis, 1969. 6 p. OWRR Project B-020-WIS.

Descriptors: *Nitrogen-fixation, *Nutrients, *Lakes, *Algae, *Nitrogen, Wisconsin.
Identifiers: *Analytical methods, *Biochemistry methods, Seasons, Acetylene reduction test.

Acetylene reduction by nitrogen-fixing organisms was used to estimate potential nitrogen fixation by blue-green algae in lakes. The method gives a useful index of nitrogen fixation with regard to the role of nitrogen-fixing agents in the eutrophication process. Lake Mendota (eutrophic), Madison, Crystal and Trout Lakes (oligotrophic), Vilas County, Wisconsin, and Little Arbor Vitae Lake (eutrophic) Vilas County, Wisconsin, were sampled at points 100 feet from shore and at mid-lake during the summer of 1968. Analyses of samples indicated that acetylene reduction varies drastically among lakes in a given area (Little Arbor Vitae Lake fixed 125-380 nanomoles C sub 2 H sub 4 N/30 minutes to less than one nanomoles for Trout Lake on July 28, 1968), and varies markedly with time in a specific lake (for Little Arbor Vitae Lake, when samples were collected on September 10, 1969, the acetylene reduction per liter of water or per mg N had decreased 10 to 20 fold from those of July 28, 1968). Acetylene reduction in lakes was studied with respect to changes in season, presence of natural-occurring algae (Gloeottichia colonies chiefly), variation in depths, and difference in light. Samples taken from Green Bay, Wisconsin were also analysed. (Kerrigan-Wisconsin)
W70-03429

A NEW POLLUTION PROBLEM,
Committee for Environmental Information, St. Louis, Mo.
For primary bibliographic entry see Field 05B.
W70-03456

OCCURRENCE AND QUALITY OF GROUNDWATER IN SHACKELFORD COUNTY, TEXAS,
Texas Water Development Board, Austin.
For primary bibliographic entry see Field 02F.
W70-03460

CHEMICAL AND DETRITAL FEATURES OF PALOUSE RIVER, IDAHO, RUNOFF FLOWAGE,
Eastern New Mexico Univ., Portales. Dept. of Biological Sciences.
For primary bibliographic entry see Field 05B.
W70-03501

PARTICULATE FRACTIONS IN WATER AND THE RELATIONSHIP TO AQUATIC MICROFLORA,
Ohio State Univ., Columbus. Dept. of Microbiology; and Ohio State Univ., Columbus. Aquatic Biology Lab.
For primary bibliographic entry see Field 05B.
W70-03505

THE MINERAL NUTRITION OF MICROCYSTIS AERUGINOSA,
Wisconsin Univ., Madison. Dept. of Botany.
Gerald C. Gerloff, George P. Fitzgerald, and Folke Skoog.
American Journal of Botany, Vol 39, p 26-32, 1952. 7 tab, 8 ref.

Descriptors: *Algae, *Nutrients, *Nutrient requirements, Growth rates, Laboratory tests, Cultures, Sodium compounds, Nitrogen.
Identifiers: *Microcystis aeruginosa (Kutz), Culture media, Chu No 10 solution, Minimum nutrients.

A Microcystis aeruginosa (Kutz) culture was made axenic by ultraviolet light and grown in basal medium of Chu No 10 solution, modified so that cations were furnished as chloride salts, and anion as the sodium salts. Minimum elemental requirements for optimum growth yield was determined by use of this medium. Small amounts of sodium were reported to be essential for the growth of Microcystis but a beneficial effect of either sodium carbonate or sodium silicate was found to be due primarily to pH control. Microcystis exhibited an optimum growth at pH of approximately 10; at this pH, sodium nitrate, sodium nitrite or ammonium chloride were equally effective nitrogen sources. When minimum nutrient concentrations were determined each in turn, a new medium composed of these concentrations was found to support maximum yields as compared to the slightly modified Chu No 10 medium. Composition of this medium, in milligrams/liter, was: nitrogen 13.6; phosphorus 0.18; sulfur 0.83; potassium 1.13; magnesium 0.13; calcium 0.25; iron 0.06; and the 'usual' amounts of sodium carbonate and sodium silicate. Disadvantages of this medium for routine use were that growth lag, pale cells, and requirements for a 'larger' inoculum was exhibited. (Gerhold-Wisconsin)
W70-03507

I. PRODUCTIVITY: PRIMARY PRODUCTIVITY STUDIES IN LAKE TAHOE, CALIFORNIA,
California Univ., Davis. Dept. of Zoology.
Charles R. Goldman, and Richard Armstrong.
Verh Internat Verein Limnol, Vol 17, p 49-71, Nov 1969. 21 fig, 3 tab, 9 ref.

Descriptors: *California, Nevada, Eutrophication, Oligotrophy, Littoral, Periphyton, Diatoms, Fungi, Streams, Carbon radioisotopes, Temperature, Light intensity, Calcium, Magnesium, Sodium, Potassium, Spectrophotometry, Nitrogen, Ammonia, Photosynthesis, Phosphates, Nitrates, Growth rates, Depth, Distance, Areal, Sampling, Surface waters, Runoff, Ultraviolet radiation.
Identifiers: *Lake Tahoe (Calif), Gomphonema constrictum, Apostemidium guernisael, Homewood (Calif), Fragilaria crotonensis, Organic growth factors, Chelation.

Lake Tahoe's enrichment and areal variability in productivity influenced by tributary streams have been investigated. Knowledge of factors causing higher production rates in certain areas should enhance evaluation of nutrients in entire lake and assist in effectively slowing eutrophication. Productivity measurements at the mouths of streams showed dispersion of stream-borne nutrients influencing primary productivity. Calculating relative photosynthetic efficiences provided best comparisons of areal variability. Relative influence of tributary waters of three streams was assessed; water from unpolluted control stream did not provoke the response as the others. Although importance of nitrogen or phosphorus was implied, stream water appeared more stimulating than its nitrogen and phosphorus content alone implied, perhaps affected by organic growth factors or natural chelating agents. Each stream bioassay was accompanied with a productivity experiment at the stream's mouth in the lake. Stimulation of photosynthesis by stream water was seasonal. Water was analyzed for calcium, magnesium, sodium, potassium and ultraviolet absorbance. Absorbance was greater in streams than lake and offered greater promise of being a water-mass indicator; its measurements in water samples, compared with productivity data, showed relationship restricted to waters around the Upper Truckee River mouth. (Jones-Wisconsin)
W70-03508

PRESIDENT'S LECTURE: LIMNOLOGY, SOCIAL WELFARE, AND LAKE KINNERET,
Uppsala Univ. (Sweden). Inst. of Limnology.
For primary bibliographic entry see Field 02H.
W70-03509

EDGARDO BALDI MEMORIAL LECTURE: CURRENT CONCEPTS IN AQUATIC MICROBIOLOGY,
Woods Hole Oceanographic Institution, Mass.
Holger W. Jannasch.
Verh Internat Verein Limnol, Vol 17, p 25-39, Nov 1969. 5 fig, 61 ref.

Descriptors: *Aquatic microbiology, Limnology, Enzymes, Carbon radioisotopes, Bicarbonates, Bacteria, Biomass, Respiration, Degradation (Decomposition), Hypolimnion, Sulfides, Eutrophication, Nitrification, Photosynthetic bacteria, Pigments, Productivity, Physiological ecology, Metabolism, Bioassay, Benthic flora, Gas chromatography, Ecology, Biochemistry
Identifiers: Uptake rate, Substrate concentration, Adenosine triphosphate, Nucleic acids, Black Sea, Autotrophic, Heterotrophic, Light absorption, Carotenoids, Bdellovibrio, Morphology, Autoradiography, Thymidine, Chemostat, Autochthonous, Steady state, Zymogenous, Suspended particles, Halophilism, Psychrophilisms, Physiology.

Ecological niches, such as sulfide-containing hypolimnia, are highly selective habitats for some specific microbial metabolic types. This area requires microbiological studies based on clear ecological concepts. In analytical approach to natural microbial populations, use of a pure bacterium culture was suggested as a 'bioassay' procedure. Where gas chromatography, atomic absorption, or enzymatic techniques fail, the bioassay may be useful. One problem in aquatic microbiology is assessing growth or metabolic transformations at minute concentrations of energy sources or essential nutrients. Advantage of determination of incorporation of labelled thymidine into cells by autoradiography lies in its specificity compared to the relatively unspecific dark uptake of labelled bicarbonate. Not until discovery that a homogeneously mixed continuous culture of an exponentially growing microorganism represents a self-adjusting system (chemostat) did continuous culture technique become invaluable in quantitative studies. While classical enrichment techniques are limited to microbial species of substrate specificity, the selective properties of the chemostat have been used for enrichments and isolations of some inconspicuous metabolic types. An aspect of microbial ecology is two species establishing a steady state, one dependent on growth limiting factor, the other controlled by metabolic products of the first. (Jones-Wisconsin)
W70-03510

NITROGEN METABOLISM IN LAKES. II. ROLE OF NITROGEN FIXATION IN SANCTUARY LAKE, PENNSYLVANIA,
Pittsburgh Univ., Pa. Dept. of Biological Sciences.
Vera A. Dugdale, and Richard C. Dugdale.
Limnology and Oceanography, Vol 7, p 170-177, 1962. 3 fig, 4 tab, 14 ref.

Descriptors: *Nitrogen fixation, *Lakes, *Eutrophication, Nitrates, Ammonia, Phosphates, Sewage, Photosynthesis, Pennsylvania.
Identifiers: Nitrogen budget, Nitrogen-15, Anabaena, Sanctuary Lake (Pa).

Using nitrogen-15, high rates of nitrogen fixation were demonstrated in Sanctuary Lake, Pennsylvania. The fixation was related to light, and therefore probably to photosynthesis. Significant fixation rates were found first in early June and rates of at least 1% per day prevailed until September. There was a correlation between the appearance of Anabaena in the spring and nitrogen fixation rates and the implication is that these organisms are probably the important primary fixers. Rates of nitrogen fixation were highest when the ammonium and nitrate concentrations were minimal. Another factor of possible importance in determining the nitrogen fixation rates in this lake is the input of raw sewage from an adjacent town. (Keeney-Wisconsin)
W70-03511

THE SHAGAWA LAKE, MINNESOTA, EUTROPHICATION RESEARCH PROJECT,
Federal Water Pollution Control Administration, Corvallis, Oreg. Pacific Northwest Water Lab.
Robert M. Brice, and Charles F. Powers.
Proceedings of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ, Berkeley, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Ore, Pac Northwest Water Lab, p 258-269. 5 fig, 4 tab.

Descriptors: *Minnesota, *Eutrophication, Sewage effluents, Tertiary treatment, Algae, Water quality, Coniferous forests, Deciduous forests, Phosphorus, Nitrogen, Cyanophyta, Chlorophyta, Diatoms, Weight, Pilot plants, Iron, Chlorella, Sodium, Potassium, Silicates, Dissolved solids, Calcium, Productivity, Standing crop, Chlorophyll, Phosphates, Additives.
Identifiers: *Shagawa Lake (Minn), Ely (Minn), Blooms, Chlorella pyrenoidosa, Microcystis aeruginosa, Burntside River (Minn).

This project sought to determine whether Shagawa Lake would recover from its presently advanced state of eutrophication if secondary sewage effluent presently entering the lake were changed to nutrient-stripped tertiary. Although data are incomplete and conclusions preliminary, studies showed lake water containing 5% secondary sewage effluent had appreciably higher algal productivity than Shagawa Lake water only or water containing 5% tertiary sewage effluent, the latter addition making no appreciable difference in the lake water. Burntside River water (80% surface inflow) containing 2% secondary sewage effluent had appreciably higher algal productivity than corresponding mixtures containing tertiary effluent. Further testing of Shagawa Lake water and Burntside River is continuing, using other concentrations of additives to explore more completely the biostimulation achieved through sewage fertilization. Additionally, experiments will be carried out in which various concentrations of nitrogen and phosphorus are added to Burntside River water, to determine whether either or both elements act to limit algal production. Anticipated results of these experiments will provide information necessary to decisions on future management policies for Shagawa Lake. (See Vol. 3, No. 7, Field 5C, W70-02775). (Jones-Wisconsin)
W70-03512

THE EFFECTS OF OIL-SPILL REMOVERS ('-DETERGENTS') ON THE GASTROPOD NUCELLA LAPILLUS ON A ROCKY SHORE AND IN THE LABORATORY,
Marine Biological Association of the United Kingdom, Plymouth (England). Lab.
G. W. Bryan.
Journal of the Marine Biology Association, U.K., Vol 49, p 1067-1092, 1969. 8 fig, 4 tab, 11 ref.

Descriptors: *Detergents, *Oily water, *Water pollution effects, Water pollution treatment, *Animal populations, Mortality, Food abundance, Resistance, Toxicity, Bioassay, Growth rates, Persistence, Migration.
Identifiers: *Torrey Canyon, *Nucella lapillus, *Growth disturbances, *Shell growth, Recolonization, Intertidal animals, BP 1002.

The effects of oil-spill removers ('detergents') on a population of Nucella Lapillus was studied at Porthleven in South Cornwall, where heavy oil pollution occurred following the Torrey Canyon incident in March 1967. At Porthleven the species was wiped out in the harbour and the majority of animals were killed on the reef nearby. Growing animals which recovered from the effects of the 'detergent' were later found to have developed growth disturbances in the shell. These effects on growth appear to be an indirect effect of 'detergent' resulting from its interference with the ability of the animal to feed and with the availability of food. Recolonization of the reef depended largely on the survival of some very young animals in the sublittoral zone. Most of the potential predators had been wiped out by the 'detergent', these animals were able to invade the reef in large numbers late in 1967. In contrast, recolonization of the outer harbour, where the species was wiped out, was slow during the first 2 years and dependent on lateral movements of animals from the reef. (Sjolseth-Washington)
W70-03513

REPRODUCTION IN BROOK TROUT (SALVELINUS FONTINALIS) FED SUBLETHAL CONCENTRATIONS OF DDT,
New Hampshire Univ., Durham. Dept. of Zoology.
Kenneth J. Macek.
Journal Fisheries Research Board of Canada, Vol 25, No 9, p 1787-1796, 1968. 1 fig, 4 tab, 17 ref. OWRR Project B-001-NH.

Descriptors: *DDT, *Fish reproduction, *Viability, *Pesticide toxicity, Brook trout, Chlorinated hydrocarbon pesticides, Mode of action fish eggs, Mortality, Pesticide residues, Gas chromatography, Growth rates.
Identifiers: *Gametes, *Sublethal effects, Chronic exposure, Sac fry.

Groups of sexually maturing yearling brook trout were fed for 156 days with DDT at .05 mg/kg per week (control, and 0.5, 1.0 and 2 mg/kg per week. The DDT caused no mortality and fish fed at the lower dosages produced more mature ova than untreated fish. The size of the male fish at the end of the feeded period was observed to increase according to the dosage of DDT. Egg and sac fry mortality was higher when at least one of the gametes came from treated fish than when they both came from untreated fish. Most mortality of sac fry in groups where the eggs came from treated fish occurred during the 15th week of development. This was the period of maximum utilization of yolk fat, thus indicating that insecticide residues in the eggs were released at this time and resulted in mortality. (Sjolseth-Washington)
W70-03515

UPTAKE AND RETENTION OF MALATHION BY THE CARP,
Michigan Univ., Ann Arbor. Dept. of Environmental Health.
Michael E. Bender.
The Progressive Fish Culturist, p 155-159, July 1969. 5 tab, 3 fig, 8 ref. Pub Health Serv . Grant ES-00016-02.

Descriptors: *Carp, *Pesticide residues, *Retention, Organophosphorus pesticides, Pesticide removal, Gas chromatography, Degradation, Persistence, Hydrolysis, Metabolism, Hydrogen ion concentration, Food chains.
Identifiers: *Malathion, *Residue distribution, Oral uptake, Aqueous uptake.

It was found that carp exposed to 5 mg/l of malathion for 4 days contained highest residue levels in the liver, and that flesh, blood, gills, and brain have decreasing concentrations. The residue half-life of malathion in carp was calculated to be 12 hours. The significance of such a rapid rate of breakdown is discussed. The differences between aqueous and oral uptake were determined. Uptake by the intestinal tract does not contribute a significant amount to the malathion residue. (Sjolseth-Washington)
W70-03516

THE TOXICITY OF THE HYDROLYSIS AND BREAKDOWN PRODUCTS OF MALATHION TO THE FATHEAD MINNOW (PIMEPHALES PROMELAS, RAFINESQUE),
Michigan Univ., Ann Arbor. Dept. of Environmental Health.
Michael Bender.
Water Research, Vol 3, p 571-582, 1969. 2 tab, 4 fig, 13 ref. US Public Health Serv Grant ES-00016-02.

Descriptors: *Hydrolysis, *Bioassay, *Degradation, Organophosphorus pesticides, Hydrogen ion concentration, Pesticide toxicity, Minnows, Mortality.
Identifiers: *Malathion, *Synergism, *Breakdown products, Pimephales promelas, DMPTA, Metabolites, Safe concentration.

Malathion undergoes hydrolysis in aqueous basic solutions to diethyl fumarate and DMPTA. The toxicity of the products of malathion hydrolysis in the fathead minnow, Pimephales promelas, were evaluated. The studies were conducted by toxicity bioassays of 96 hr duration and continuous exposure test of 14 day duration. The results of the experiments demonstrated the following: (1) the basic hydrolysis product, diethyl/fumurate, was more toxic than malathion to the test species; (2) a pronounced synergistic effect was demonstrated between malathion and its two basic hydrolysis products; and (3) continuous exposure decreased the TLm concentration of malathion and its basic hydrolysis products. (Sjolseth-Washington)
W70-03518

EFFECTS OF FIVE HERBICIDES ON THREE GREEN ALGAE,
North Texas State Univ., Denton. Dept. of Biology.
B. Dwain Vance, and David L. Smith.
Texas Journal of Science, Vol XX, p 329-337, Apr 1969. 1 tab, 41 ref.

Descriptors: *Herbicides, *Growth rates, *Algae, 2-4-D, Aminotriazole, 2-4-5-T, Scenedesmus, Chlamydomonas, Chlorella, Mortality, Bioassay, Inhibition, Mode of action, Photosynthesis.
Identifiers: Simazine 80 W, Dacthal.

Screening tests were made to determine if the herbicides Simazine 80W, Dacthal, Amitrol-T, 2,4-D, and 2,4,5-T were toxic to bacteria-free unialgal cultures of Scenedesmus quadricauda, Chlamydomonas eugametos, and Chlorella pyrenoidosa TX 7-11-05. Dacthal, Simazine, 2,4-D and 2,4,5-T showed no toxic effects on any of the algae at concentrations up to 200 ug/ml. Simazine increased the growth of C. eugametos in concentrations up to 200 ug/ml. Amitrol-T was inhibitory to all the algae at high concentrations but showed no effect at concentrations below 150 ug/ml. (Sjolseth-Washington)
W70-03519

BIOLOGICAL CONCENTRATION OF PESTICIDES BY ALGAE,
North Texas State Univ., Denton. Dept. of Biology.
B. Dwain Vance, and Waymon Drummond.
Journal American Water Works Association, Vol 61, No 7, p 360-362, July 1969. 2 tab, 11 ref. US Public Health Serv Research Grant CC 00269.

Descriptors: *Algae, *Pesticide toxicity, *Pesticide removal, *Food webs, DDT, Chlorinated hydrocarbon pesticides, Aldrin, Endrin, Dieldrin, Scenedesmus, Gas chromatography, Resistance, Bioassay, Growth rates, Pesticide residues, Deterioration.
Identifiers: *Biological concentration, Anabaena cylindrica, Microcystis aeruginosa, Oedognium.

Unialgal cultures of Microcystis aeruginosa, Anabaena cylindrica, Scenedesmus quadricauda, and Oedogonium sp. were grown in the presence of aldrin, dieldrin, endrin and DDT in concentrations of 5, 10 and 20 ug/ml. These algae are effective in accumulating pesticides from the medium in which they grow. In no case was concentration less than 100 fold. Algae were shown to accumulate detectable quantities within 30 minutes after exposure. The algae were shown to be highly resistant to the pesticide, except that dieldrin, aldrin, and endrin are algicidal to M. aeruginosa at concentration of less than 5 ug/ml. The authors feel that the ability of algae to concentrate pesticides without themselves succumbing may be a potential danger to organisms higher up the food chain. (Sjolseth-Washington)
W70-03520

SOME EFFECTS OF CARBON DIOXIDE ON THE BLOOD OF RAINBOW TROUT Salmo gairdneri RICHARDSON,
Ministry of Agriculture, Fisheries and Food, London (England). Salmon and Freshwater Fisheries Lab.
F. B. Eddy, and R. I. G. Morgan.

Journal of Fisheries Biology, Vol 1, p 361-372, 1969. 6 tab, 3 fig, 37 ref.

Descriptors: *Carbon dioxide, *Fish physiology, *Acclimatization, Rainbow trout, Toxicity, Respiration, Oxygenation.
Identifiers: *Fish blood, *Blood analysis, *Bohr effect, *Root effect, Oxygen capacity, Hematocrit, Hemoglobin, Blood iron content, Erythrocyte.

Various hematological measurements, including pH determinations were made on blood from rainbow trout acclimated to 40 ppm free CO2 and 70 to 100 ppm free CO2 in order to investigate any differences occurring in the respiratory properties of the blood. When equilibrated with various CO2 tensions, blood from acclimated trout showed smaller Bohr and Root effects than blood from the non-acclimated trout. Blood from acclimated trout contained more hemoglobin which was not completely saturated with oxygen when equilibrated in air. Oxygen dissociation curves were constructed and evaluated. The authors concluded that rainbow trout can acclimate to some extent, to the stress of high CO2 levels. Thus trout inhabiting water liable to pollution from CO2 can accommodate this stress to some extent. (Sjolseth-Washington)
W70-03522

SOME FACTORS INFLUENCING SUSCEPTIBILITY OF RAINBOW TROUT TO THE ACUTE TOXICITY OF AN ETHYL MERCURY PHOSPHATE FORMULATION (TIMSAN),
Western Fish Disease Lab., Seattle, Wash.
Donald F. Amend, William T. Yasutake, and Reginald Morgan.
Transactions of the American Fisheries Society, Vol 98, No 3, p 419-425, 1969. 1 fig, 4 tab, 12 ref.

Descriptors: *Rainbow trout, *Bioassay, Water temperature, Dissolved oxygen, Calcium carbonate, Water pollution effects, Toxicity, Fish kill.
Identifiers: *Ethyl mercury phosphate, *Timsan, *Susceptibility, *Mercury, Water hardness, Chloride ions.

This study determined the influence of water temperature (55-68 deg), dissolved oxygen (4-12 ppm), water hardness as CaCO3 (20-256 ppm), and chloride ions (to 2mM) on the susceptibility of rainbow trout (Salmo gairdneri) to the acute toxicity of ethyl mercury phosphate (EMP). The fish were exposed for one hour to 0.125 ppm EMP, the active ingredient of Timsan, a commercial EMP formulation. The death rate because of the exposure to EMP increased with an increase in water temperature, a decrease in dissolved oxygen, and an increase in chloride ions; calcium appeared to have no effect. The effect of water temperature and dissolved oxygen was ascribed to changes in the respiration rate of the fish, and a chemical explanation is presented for the effect of chloride ions. (Sjolseth-Washington)
W70-03523

THE DIURETIC RESPONSE BY RAINBOW TROUT TO SUB-LETHAL CONCENTRATIONS OF AMMONIA,
Ministry of Agriculture, Fisheries and Food, London (England). Salmon and Freshwater Fisheries Lab.
R. Lloyd, and Lydia D. Orr.
Water Research, Vol 3, p 335-344, 1969. 6 fig, 19 ref.

Descriptors: *Ammonia, *Urine, *Acclimatization, Rainbow trout, Permeability, Fish physiology, Toxicity, Water temperature, Laboratory equipment.
Identifiers: *Diuresis, *Urine excretion rates.

The rate of urine excretion by rainbow trout increases with a rise in the concentration of ambient un-ionized ammonia. It is suggested that this diuresis is caused by an increase in the permeability of the fish to water. Quantitative measurements of urine excretion rates indicate that concentrations of un-ionized ammonia below 12 per cent of the lethal threshold concentration may be without toxic effect. Increases in temperature produce no well defined trend in urine excretion rates with a given concentration of un-ionized ammonia, but normal excretion rates have a Q10 of 2.4. Some evidence is presented for acclimation of rainbow trout to sub-lethal levels of ammonia. It is suggested that any environmental factor which affects the water balance of fish may also influence their susceptibility to ammonia poisoning. (Sjolseth-Washington)
W70-03524

ACCUMULATION OF DIELDRIN BY FISH AND SELECTED FISH-FOOD ORGANISMS,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
George G. Chadwick, and Robert W. Brocksen.
The Journal of Wildlife Management, Vol 33, No 3, p 693-700, 1969. 8 fig, 14 ref.

Descriptors: *Pesticide removal, *Pesticide residues, Dieldrin, Sculpins, Tubificids, Retention, Chlorinated hydrocarbon pesticides, Gas chromatography, Persistence, Pesticide toxicity.
Identifiers: *HEOD, *Accumulation rates, *Method of uptake, Cottus perplexus, Chironomidae.

The rate of uptake of HEOD (a dieldrin component) from contaminated water (0.017 to 8.6 parts per billion (ppb)) or food by the reticulate sculpin (Cottus perplexus) and fish-food organisms, tubificid worms (Tubifex sp.) and midge larvae (Chironomidae) was determined. Accumulation of HEOD by the fish was dependent on its concentration in the water, and the accumulation was nearly constant at each exposure level during the 32-day test period. The saturation level of HEOD in the fish apparently was never reached. Feeding experiments using contaminated tubificid worms as the food source, showed that the retention of HEOD by fish was inversely related to the amount of HEOD they consumed. Fish retained nearly all of the HEOD they consumed when given small amounts in their food, but they retained a much lower proportion of the available HEOD when given large amounts in food. Authors concluded that fish can accumulate HEOD both from the surrounding water and from their food, but accumulation of HEOD from the water does not appear to be additive with the HEOD accumulated from the food. (Sjolseth-Washington)
W70-03525

THE EFFECTS OF TEMPERATURE ON THE SUSCEPTIBILITY OF BLUEGILLS AND RAINBOW TROUT TO SELECTED PESTICIDES,
Bureau of Sport Fisheries and Wildlife, Columbia, Mo. Fish-Pesticide Research Lab.
Kenneth J. Macek, Curt Hutchinson, and Oliver B. Cope.
Bulletin of Environmental Contamination and Toxicology, Vol 4, No 3, p 174-183, 1969. 3 tab, 7 ref.

Descriptors: *Bioassay, *Pesticide toxicity, Rainbow trout, Water temperature, Mode of action, Pesticide removal, Chlorinated hydrocarbon pesticides, Organophosphorus pesticides, Aldrin, Dieldrin, Endrin, Heptachlor, Fish physiology.
Identifiers: *Susceptibility, *Median tolerance limits, Bluegills, Chlordane, Lindane, Malathion Methoxychlor, Endosulfan, Toxaphene, Pesticide uptake, Enzymatic activity.

The median tolerance limits to 15 pesticides were calculated for 24 and 96 hours of exposure at 1.6 deg, 7.2 deg and 12.7 deg C for rainbow trout and at 12.7 deg, 18.3 deg and 23.8 deg C for bluegills. The pesticides tested were aldrin, chlordane, naled, dieldrin, diuron, Dursban, endrin, azinphosmethyl, heptachlor, lindane, malathion, methoxychlor, endosulfan, toxaphen, and trifluralin. There was generally an increase in the susceptibility of fish to most pesticides tested as temperature increased. The authors feel this increased susceptibility to be due to an increased level of enzymatic activity and possibly to the effect of temperature on metabolism. The authors stressed the need for considering interactions between pesticides and environmental factors when determining safe levels in aquatic habitats. (Sjolseth-Washington)
W70-03526

RESPONSE OF THE INTERRENAL GLAND OF RAINBOW TROUT (SALMO GAIRDNERI) TO STRESS,
Michigan State Univ., East Lansing. Dept of Physiology.
Cliff W. Hill, and Paul O. Fromm
General and Comparative Endocrinology, Vol 11, No 1, p 69-77, 1968. 6 tab, 31 ref FWPCA Grant WP 00807.

Descriptors: *Stress, *Chromium, *Fish physiology, Rainbow trout, Fluorescence, Test procedures.
Identifiers: *Plasma cortisol, *Plasma glucose, *Interrenal gland, Liver glycogen, ACTH.

Exposure of trout to environmental hexavalent chromium (0.02 and 0.2 mg/liter of water) for 1 week caused a significant elevation of plasma 'cortisol' as determined by fluorescence in sulfuric acid. Fish exposed to these concentrations for 2 and 3 weeks had plasma levels similar to those of controls. Forced exercise twice daily for 1 and 2 weeks did not give rise to elevated plasma 'cortisol' if samples were obtained 24 hours after the last exercise period. Fish forced to swim and sampled immediately did have plasma 'cortisol' levels significantly above those of controls. Animals treated with exogenous cortisol had plasma 'cortisol' levels over 100 ug/100 ml. Fasted fish so treated for 1 week had higher liver glycogen stores and excreted more waste nitrogen than did control fish. Plasma glucose was not elevated in treated fish. Animals similarly treated but fed during the experimental period had liver glycogen stores and nitrogen excretion rates similar to those of controls. (Sjolseth-Washington)
W70-03527

THE EFFECT OF SOME MYCOTOXINS ON THE BRINE SHRIMP, ARTEMIA SALINA,
Food and Drug Administration, Washington, D.C. Div. of Microbiology.
R. F. Brown.
Journal of the American Oil Chemists' Society, Vol 46, No 2, p 119, 1968. 1 fig, 3 ref.

Descriptors: *Brine shrimp, *Bioassay, Mortality, Toxins.
Identifiers: *Aflatoxia B1, *Ochratoxin A, Artemia salina, Aflatoxins, Mycotoxins.

The chemical determination of nycotoxins in foods using bioassay techniques with the brine shrimp, Artemia salina, was discussed. Aflatoxin B1, at dose levels of 1.0 ug/ml and above, produced over 90% mortality after 24 hours. At 0.5 ug/ml there was a 61% mortality of Artemia. Ochratoxin A, at 1.0 ug/ml produced a 15% mortality; at 2.0 ug/ml, mortality was 23%; at 16.0 ug/ml, mortality was 49%. Further investigation is warranted on the possibility of using brine shrimp as a bioassay for other mycotoxins. (Sjolseth-Washington)
W70-03528

COMPARATIVE HYDROCHEMICAL CHARACTERISTIC OF RESERVOIRS - COOLERS OF STATE REGIONAL ELECTRIC POWER (HEAT) STATIONS OF THE UKRAINE (In Russian),
Akademiya Nauk URSR, Kiev. Instytut Hidrobiologii.
S. I. Abremskaya.
English summary. Gidrobiolo gicheskii zhurnal, Vol 5, No 1, p 38-42, 1969. 1 tab, 8 ref, 2 fig.

Descriptors: *Cooling, *Reservoirs, Environmental effects, Thermal pollution, Dissolved oxygen, Chemical properties, Ponds, Photosynthesis.

Identifiers: Cooling ponds, Effects on chemical properties, Temperature effects.

Hydrochemical characteristics of cooling ponds of 5 Ukrainian electrical power stations were examined in this study. The waters of the Kurakhov and Zuyer cooling ponds were characterized by high mineralization and hardness; the total ions were somewhat lower in the Lupansk and Zmiyer cooling ponds, and the lowest values were found in the cooling pond of the Krivoi Rog electric power station. The discharge of heated waters did not substantially effect the ion-salt components of the ponds. The content of biogenic and organic substances and gas condition in the ponds depended chiefly on local conditions of effluents and internal processes. The ponds studied were eutrophic and mesotrophic according to their production levels. The effect of increased temperature was mostly visible in gas production and in the dynamics of organic and biogenic substances. According to winter data, the pH in heated parts of the ponds was somewhat higher than in cooler areas. It is probable that photosynthesis is more active in the heated parts in this period, which favors more intensive accumulation of organic matter. Also, BOD was much higher in heated than in cool portions. As a result of increased temperature, solubility of O2 in the cooling ponds decreased. The concentration of O2 in the heated parts of cooling ponds in winter was lower than in parts under natural conditions. Local decrease of O2 content in warm parts may be explained also by higher mineralization of organic matter and respiration of hydrobiants. The content of biogenic elements in warmer parts of the ponds was somewhat lower than in cooler portions, which may be explained by their greater consumption by phytoplankton. The quality of waters in cooling ponds can be improved by maximum water-exchange and the removal of excess salts. (Novotny-Vanderbilt)
W70-03539

THE RETURN OF THE BLUEBACK SALMON TO THE COLUMBIA RIVER,
Frederic F. Fish.
Scientific Monthly, Vol 66, p 283-292, 1948. 2 tab.

Descriptors: *Columbia River, *Grand Coulee Dam, *Relocation, Spawning Brood Stock.
Identifiers: *Parent Stream Theory, Blueback salmon.

The year 1941 was a critical one for the blueback salmon of the Columbia River, for one brood of the species came very close to extinction. Only 949 fish were counted passing Rock Island Dam to the spawning grounds. The most acceptable explanation for the small number of fish reaching the spawning grounds lies in the abnormally warm water temperatures that prevailed that year. The high temperatures are believed to have caused the blueback to turn into downstream tributaries seeking relief from the warm water, and to have established a favorable environment for Chrondrococcus columnaris. As a result of the construction of Grand Coulee Dam, which blocked the entrance to the upper Columbia blueback spawning grounds, the Fish and Wildlife Service began a relocation project which was predicated upon the assumption that the young of the relocated fish would return to the streams in which they were reared, and not to their ancestral spawning areas. The fish were trapped in the fish ladders at Rock Island Dam and trucked to hatcheries where young were artificially propagated. The relocation project was begun in 1940, but it was not until 1943 that an effective disinfectant was found which eliminated all infectious diseases without danger to the blueback fingerlings. By that time a diet had been compounded which met all nutritional requirements of the fish. The loss of eggs and fingerlings was reduced from 83.4% in 1940 to 16.3% in 1943. The 1947 run demonstrated the success of the 1943 hatch, when 204,489 fish were estimated in the Columbia River. The estimated run in 1945, progeny of the fish trapped in the 1941 run was only 9,269. The relocation project appeared to have been successful and the blueback salmon had returned to the Columbia River. (Speakman-Vanderbilt)
W70-03546

EFFECT OF ORGANIC WASTE AND COOLING WATER ON SELF-PURIFICATION OF WATERS,
Technische Hochschule, Aachen (West Germany).
B. Boehnke.
Purdue University, Eng Bull, PT 2 Ext Ser No 129, p 752-770, 1967.

Descriptors: Water pollution effects, *Cooling water, *Thermal pollution, *Self-purification, *Organic loading, Wastes, Waste assimilative capacity, Rivers, Watersheds (Basins), Biochemical oxygen demand, Oxygen sag, Dissolved oxygen.

Results achieved within the area of the Lippe Association illustrate what effect biological degradable industrial wastes may have on the self-purification capacity of flowing waters and what measures were, and still are, necessary for observing and improving conditions within a river basin. The effects of biological degradable industrial waste water and the discharge of cooling water on the self-purification capacity of the Lippe River can be estimated with satisfactory accuracy for long stretches of the river. The method of calculating the effect of organic loads on the process of self-purification as employed by the Lippe Association has proved to be a valuable help in establishing economical improvement schemes, in specific treatment measures, and in fixing contributions. It is an essential condition that O2 replenishment via the water surface and degradation rates within the river be known. Although the complex conditions prevailing in a water course rule out an exact precalculation of O2 conditions, as a characteristic feature of the process of self-purification under changing load conditions, it is possible to make a reliable estimate of biological processes. This will materially assist an engineer in his designs and studies and will help him in making necessary decisions. (Novotny-Vanderbilt)
W70-03547

THE EFFECTS OF IMPOUNDING RESERVOIRS ON RIVER WASTE ASSIMILATIVE CAPACITY,
Vanderbilt Univ., Nashville, Tenn. Dept. of Environmental and Water Resources Engineering.
Peter A. Krenkel, William A. Cawley, and Virgil A. Minch.
Journal Water Pollution Control Federation, Vol 37, No 9, p 1203-1217, Sept 1965. 16 fig, 14 ref.

Descriptors: *Impoundments, *Waste assimilative capacity, Dissolved oxygen, Stratified flow, Backwater, Peak Power, Cooling water, Unsteady flow, Temperature, Thermal pollution.
Identifiers: *Weiss Reservoir, *Coosa River.

The major undesirable conditions which affect the observed reduction in waste assimilation capacity of previously unregulated rivers by the construction of impounding reservoirs are described. These major factors are the inherent low dissolved oxygen values in stratified reservoirs, the backwater conditions created by the downstream reservoir, the peaking power operations, and the stratified flow conditions induced by the discharge of cooling water into deep, slow-moving backwaters. The data presented show that the conditions created by the closure of Weiss Reservoir have reduced the waste assimilative capacity of the Coosa River by 80 percent of that obtained in the pre-impoundment free-flowing stream. The causes are the presence of the backwater curve caused by the Weiss Reservoir, unsteady flow conditions created by the cyclic power releases from the upstream Allatoona Reservoir, the stratified flow conditions created by the discharge of a heated power plant effluent, and the inherent changes in normal water quality caused by the presence of both reservoirs. (Rietveld-Vanderbilt)
W70-03550

EFFECT OF WATER TEMPERATURE ON DISCHARGE AND BED CONFIGURATION, MISSISSIPPI RIVER AT RED RIVER LANDING, LOUISIANA,
Corps of Engineers, Washington, D.C. Committee on Channel Stabilization.
P. P. Burke.
Committee on Channel Stabilization, Corps of Engineers, Technical Report No. 3, Aug 1966. 45 p, 6 fig, 6 tab, 18 ref.

Descriptors: *Water Temperature, Viscosity, Shape, River bed, Sand waves, Mississippi River.
Identifiers: Alluvial river, Gage hydrograph, Flood damage potential, Bed form, Configuration changes, Discharge.

The configuration of the bed of an alluvial river varies in accordance with the temperature of the water. Crossings and bends are lowered and systematic sand waves are redcuced in amplitude in a direct relation to decreasing water temperatures. The mechanism by which this occurs may be physical or chemical, or a combination of the two. Routine surveys made for other purposes afford a quantity of basic data to delineate changes in bed configuration. An examination of the basic data from field observations and from official Mississippi River Commission publications indicates water temperature has a real effect on bed form configuration. There is a need for continued investigation in this field through model study and field observations of the prototype. The presentation of these data is only a beginning and no attempt is made to explain the complicated mechanisms by which temperature accomplishes its apparent effect on sediment movement and deposition. Ross-Vanderbilt
W70-03552

AN EFFECT OF WATER HARDNESS IN THE THERMAL RESISTANCE OF THE RAINBOW TROUT, SALMO GAIRDNERII Richardson,
Toronto Univ. (Ontario). Dept. of Zoology.
David E. Craigie.
Canadian Journal of Zoology No 41, p 825-830, 1963. 2 fig, 2 tab, 5 ref.

Descriptors: *Water temperature, *Hardness, *Fish behavior, *Rainbow trout, Thermal stress, Saline water, Salinity, Trout, Fish, Environmental effects.
Identifiers: *Thermal resistance, Salmo gairdnerii, Hardwater, Softwater.

Resistance to thermal stress was studied in 2 groups of yearling trout (Salmo gairdnerii) in soft and saline waters at 27, 28, and 29 deg C. In all cases the group reared in soft water showed greater resistance to thermal stress than the group reared in hard water but otherwise under similar conditions. This difference in thermal resistance was associated not with experience in the development period (between fertilization and final adsorption of the yolk sac) but with experience in the subsequent growth period. It was also confirmed that increased salinity in the testing medium increased the thermal resistance; with fish reared in hard water, this effect was insignificant at a relatively low lethal temperature (27 deg C) but increased at higher temperatures, while with fish reared in soft water the advantage of increased salinity was significant at all 3 temperatures but greater at 28 deg C than at either 27 or 29 deg C. (Rietveld-Vanderbilt)
W70-03554

TEMPERATURES SELECTED BY TILAPIA MOSSAMBICA (PETERS) IN A TEST TANK WITH A HORIZONTAL TEMPERATURE GRADIENT,
University of the Witwatersrand, Johannesburg (South Africa). Dept. of Zoology.
T. R. Badenhuizen.
Hydrobiologia, No 30, p 541-554, 1967. 6 fig, 1 tab, 11 ref.

Descriptors: *Water temperature, *Fish behavior, *Fish, Thermal pollution, Temperature, Environmental effects.

Identifiers: *Temperature gradient, Tilapia mossambica, Temperature preference.

Investigations were made of the effects of temperature on juvenile Tilapia mossambica in long 21-compartment horizontal tanks with further compartments at either end containing an immersion heater and an ice block respectively, the fish being able to pass along the tank by swimming under the partitions, which were raised from the bottom With no temperature gradient along the tank the distribution was not random, owing to congregation of the fish towards the ends of the tanks, but when a temperature gradient was applied, the fish preferred to congregate in compartments in which the temperatures ranged from about 27 deg C to 33.5 deg C. Selected temperatures were higher than those occurring in the natural habitat of the fish. These results confirm that death of Tilapia in highveld dams in winter is due to low temperatures. (Rietveld-Vanderbilt)
W70-03556

EFFECTS OF TEMPERATURE UPON THE FORMATION OF VERTEBRAE AND FIN RAYS IN YOUNG CHINOOK SALMON,
Washington Univ., Seattle. Lab. of Radiation Ecology.
Allyn Seymour.
Transactions of the American Fisheries Society, Vol 88, No 1, p 58-69, 1959. 7 fig, 4 tab, 31 ref.

Descriptors: *Temperature, *Chinook salmon, *Eggs, Fish, Fish physiology.
Identifiers: *Vertebrae, *Fin rays, Fingerlings, Fish development.

Experiments in each of three successive years were designed to observe the effect of temperature upon chinook salmon, Oncorhynchus tshawytsch, during the period from the egg to the fingerling stage. Experimental temperatures ranged from 34 deg F to 74 deg F but there were no survivals to the stage where vertebrae or fin rays could be counted for lots reared at temperatures below 39 deg F or above 62 deg F. Two experiments were conducted at constant temperatures, while, in the third, the temperatures were lowered to 34 deg F from their initial levels at the rate of 1 deg F per 5 days. The temperatures were then held at 34 deg F for twenty days, after which they were raised 1 deg F per 5 days. For these experiments the average numbers of vertebrae per lot was less for lots reared at temperatures in the middle portion of the 39 deg F to 62 deg F range than for lots reared at either extreme of the range. The same effect was observed in regard to the number of individuals with abnormal vertebrae, but the opposite effect was observed in regard to the numbers of rays in the anal and dorsal fins. The difference in the average number of vertebrae of lots reared at various temperatures was less than the difference in the average number of vertebrae between the four stocks. The average numbers of vertebrae in the lots from the Sacramento River (California) and the three Washington rivers - Skagit, Green and Entiat - and reared at the same temperature (56 deg F) were respectively 66.39 plus or minus .047, 68.36 plus or minus .052, 69.57 plus or minus .23, and 71.73 plus or minus .031. For all lots the range in number of vertebrae was 63 to 78. (Speakman-Vanderbilt)
W70-03557

EFFECT OF HEAT ON THE LIGHT BEHAVIOUR OF FISH,
Toronto Univ. (Ontario).
C. W. Andrews.
Transactions, Royal Society of Canada, Section V, p 27-31, 1946. 2 fig, 1 ref.

Descriptors: Temperature, Light, Behavior, Acclimatization, Suckers, Fish behavior, Thermal pollution, Fish attractants, Fish repellants, Light intensity.

The effect of heat on the light behavior of the common sucker (catostomus commersonnii) has been studied. Two-year-old suckers were found to be negatively phototactic at depths of 8 and 12 inches, while they were positively phototactic at 16 inches or more depth. All sizes tested were found to become insensitive to light at temperatures less than lethal and they regained light sensitivity if the temperatures were lowered again. The temperature of insensitivity to light decreased with increased age. The temperature of insensitivity to light varied directly with temperature of acclimation, increasing from 20.3 deg C to 32.5 deg C for acclimation temperatures of 5 deg C to 22 deg C respectively, for light of constant intensity. The temperature of insensitivity also varied directly with light intensity, increasing from 10.5 deg C to 20.5 deg C for relative light intensities of 1 and 1000 respectively. (Speakman-Vanderbilt)
W70-03558

WATER TEMPERATURE AND SPRING FISHING, NORRIS RESERVOIR, TENNESSEE,
Tennessee Valley Authority, Norris.
Jack S. Dendy.
Journal, Tenn. Academy of Science, Vol. 21, p 89-93, 1946. 2 fig, 1 tab, 4 ref.

Descriptors: *Temperature, *Fishing, Spring, Stratification, Thermal stratification, Fish behavior, Creel census, Fish, Fish management, Tennessee.
Identifiers: *Norris Reservoir, Clinch River.

During the early spring of 1945, water temperatures were taken at regular intervals at three stations on Norris Reservoir. One station was in the deepest portion of the Reservoir, another in a moderately shallow area about 25 miles above the dam, and the third about midway between the other two. As expected, the water temperature increased more rapidly in the upper portion of the Reservoir than in the deeper parts near the dam. The surface water was consistently much warmer at the upstream station than at the deepwater station until early April. Inquiries of anglers and dock operators showed that anglers were taking fish in the upstream area as early as March 1, while at the deep water station the fish had not begun to bite. By early April, however, fishing in the downstream area was almost as good as in the upper region. (Speakman-Vanderbilt)
W70-03559

INCREASED SENSITIVITY TO PESTICIDES IN SHEEPSHEAD MINNOWS,
Bureau of Commercial Fisheries, Gulf Breeze, Fla. Biological Lab.
H. T. Holland, David L. Coopage, and Philip A. Butler.
Transactions of American Fisheries Society, Vol 95, No 1, p 110-112, 1966. 2 fig, 3 ref.

Descriptors: *DDT, *Endrin, *Bioassay, Resistance, Chlorinated hydrocarbon pesticide, Mortality, Fishkill, Pesticide toxicity, Water pollution effects.
Identifiers: *Sensitivity, *Sheepshead minnows.

Sheepshead minnows were exposed to 20 to 40 ppb DDT in aquaria for 24 hours. Survivors of DDT tests in which mortality exceeded 90% (R1 fish) and survivors of DDT with mortality from 55 to 90% (R2 fish) were transferred to artificial pools similar to the natural environment. The young of these fish and control fish were exposed to DDT (10, 13, and 15 ppb) and endrin (2 ppb). R1 young under went higher mortalities than the controls in all tests. Mortality of R2 young was greater than controls at 13 ppb DDT and in endrin. The authors feel these data indicate that a population of sheepshead minnow could tolerate an occasional heavy mortality. The increased sensitivity of the F1 generation indicate that serious mortality may result following low levels of pesticide contamination. (Sjolseth-Washington)
W70-03621

AVOIDANCE OF PESTICIDES BY UNTRAINED SHEEPSHEAD MINNOWS,
Bureau of Commercial Fisheries, Gulf Breeze, Fla.
David J. Hansen
Transactions of American Fisheries Society, Vol 98, No 3, p 426-429, 1969. 3 tab, 1 fig, 5 ref

Descriptors: *DDT, *Endrin, *2-4-D, *Fish behavior, Pesticide toxicity, Bioassay, Research equipment, Fish repellents, Organophosphorous pesticides.
Identifiers: *Avoidance, *Malathion, *Dursban, *Sevin, Sheepshead minnows, Ecological implications, Median tolerance limits, Pesticide concentrations.

The capacity of sheepshead minnows, Cyprinodon varigatus to avoid various concentrations of six pesticides (DDT, endrin, malathion, Dursban (R), Sevin (R), and 2-4D) was investigated. Test fish avoided water containing DDD (down to .005 ppm), endrin (.0001 ppm), Dursban (.1 ppm), and 2-4D (.1 ppm). The fish did not avoid the test concentrations of malathion or Sevin. When fish were exposed simultaneously to two different concentrations of the four pesticides that were avoided, they avoided the highest concentration of 2,4D but preferred the higher concentration of DDT. Fish did not discriminate between other concentrations of 2,4D or between different concentrations of endrin or Dursban. (Sjolseth-Washington)
W70-03622

SURVIVAL OF FISH IN 164 HERBICIDES, INSECTICIDES, FUNGICIDES, WETTING AGENTS AND MISCELLANEOUS SUBSTANCES,
Ministry of Agriculture, Fisheries and Food, London (England). Salmon and Freshwater Fisheries Lab.
J. S. Alabaster.
International Pest Control, Vol II, No 2, p 29-35, Apr 1969. 1 fig, 7 ref, 7 tab.

Descriptors: *Bioassay, *Chlorinated hydrocarbon pesticides, *Organophosphorus pesticides, *Herbicides, *Fungicides, Pesticide toxicity, Pesticide residues, DDT, Rainbow trout, Brown trout, Hydro ion concentration, Analytical techniques, Hardness (Water).
Identifiers: *Rasbora heteromorpha (Harlequin), *Wetting agents, Plaice, Sheepdip.

Tests by the Salmon and Freshwater Fisheries Laboratory in London were conducted to measure the toxicity of 164 pesticides to fish. Harlequin fish (Rasbora heteromorpha), rainbow trout, brown trout and plaice were the test fish. The 24 and 48-hour median lethal concentrations, together with the estimated mean threshold values (concentration at which 50% of the fish would be killed in 3 months) are given for herbicides, fungicides, insecticides, excluding DDT and sheep dips, wetting agents and miscellaneous substances. In general the relationship between the logarithm of survival time and the logarithm of material concentration is non-linear, often indicating a threshold concentration for survival. The results suggest it is essential to test actual pesticide as sold rather than rely on figures available for the toxicity of the ingredients. In only very few cases was the toxicity of a formulated compound dependent simply on the amount of active ingredient. (Sjolseth-Washington)
W70-03623

THE EFFECTS OF A ROTENONE TREATMENT ON THE INSECT FAUNA OF A CALIFORNIA STREAM,
California Univ., Davis. Dept. of Zoology; and California State Dept. of Fish and Game, San Francisco.
S. F. Cook, Jr., and R. L. Moore.
Transactions of American Fisheries Society, Vol 98, No 3, p 539-544, 1969. 3 ref, 6 fig.

Descriptors: *Rotenone, *Aquatic insects, Water pollution effects, Diptera, Caddisflies, Mayflies,

Persistence, Larvae, Treatment, Fish control agents.
Identifiers: *Recovery, *Insect fauna, Russian River, California, Ephemeroptera, Trichopters, Simuliids.

The population levels of the major insect groups subsequent to rotenone treatment in the treated and untreated zones in Robinson Creek were examined in both pools and riffles. A great resurgence of insect fauna after their initial near annihilation in the treated zone was noticed. The simuliids were the first major group to make a comeback in the treated riffles. Within two weeks they had taken over all available attachment space in the riffles. The authors feel that elimination of potential predators may account for this resurgence. It appears as if rotenone treatment had little lasting effect upon the non-target insect fauna of significance as fish forage. The authors caution relating these data to other instances of stream poisoning, since only a portion of Robinson Creek was treated. Season of treatment, sampling biases, and possible undetected species shifts are other points to be considered in evaluation of such projects. (Sjolseth-Washington)
W70-03624

5D. Waste Treatment Processes

INJECTION WELL EXPERIENCE AT RIVERHEAD, N.Y.,
Baffa (John J.), New York.
For primary bibliographic entry see Field 04B.
W70-03249

OPPORTUNITIES FOR WATER SALVAGE,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
Lloyd E. Myers.
Civil Engineering - ASCE, Vol 40, No 1, p 41-44, Jan 1970. 4 p, 2 photo, 1 tab.

Descriptors: *Water reuse, *Reclaimed water, Tertiary treatment, Water supply, Irrigation water, Water management (Applied), Water resources development, Evaporation, Water harvesting, Evaporation control, Water conservation.
Identifiers: Water salvage techniques.

While the focus of attention for increasing water supplies has been on developing new supplies, there has been a relative neglect of the equally important sources of supply in water salvage. Some of these sources, such as wastewater reclamation and reuse of water by industry, are economically feasible today. Others such as reducing some irrigation use, are feasible today but their development will be delayed by social and economic factors which are difficult to predict. Such sources as vegetation management and water harvesting, can be expected to become economically feasible and socially acceptable within the next decade. These water salvage methods will ultimately make a major contribution to the solution of water supply problems. (Knapp-USGS)
W70-03251

ISRAEL TURNS TO SEWAGE FOR WATER.

Engineering News Record, Vol 183, No 19, p 42-43, Nov 6, 1969. 2 p, 1 fig, 3 photo.

Descriptors: *Water reuse, *Tertiary treatment, *Artificial recharge, Water spreading, Aerobic treatment, Anaerobic treatment, Arid lands, Desalination, Reclaimed water, Groundwater movement, Aquifers, Pumping.
Identifiers: *Israel.

With 90% of its water potential now being used and faced with the prospect of a 20% to 30% increase in demand for the next decade, Israel is turning to raw sewage as a source of supply. Under construction is a waste water reclamation project expected to hike the nation's supply by 12%. The effluent, to be reclaimed by treatment in sophisticated lagoons, will not be put into use directly but will be infiltrated into the ground and later recovered by wells. The spreading basins will be located in sand dunes that connect directly with the underlying sand-and-sandstone aquifer that is one of Israel's principal stores of groundwater. The treatment phases of the various lagoons include anaerobic lagoons, facultative lagoons, aerobic lagoons and a polishing lagoon. The spreading lagoons will be operated in rotation to allow for drying periods between successive fillings to prevent clogging. The infiltrated water will take one year or more to reach the periphery of the recharge area, where an encompassing string of borehole wells will recapture the water as a potable supply. Salinity will be about 300 ppm. Most of the reclaimed water will be used for irrigation. (Knapp-USGS)
W70-03270

EFFECT OF SURFACE/VOLUME RELATIONSHIP, CO-sub-2 ADDITION, AERATION, AND MIXING ON NITRATE UTILIZATION BY SCENEDESMUS CULTURES IN SUBSURFACE AGRICULTURAL WASTE WATERS,
California State Dept. of Water Resources, Fresno; and Federal Water Pollution Control Administration, Fresno, Calif.
Randall Brown, and James Arthur.
Proceedings of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ, Berkeley, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Ore, Pac Northwest Water Lab, p 80-97. 12 fig, 1 tab, 1 ref.

Descriptors: *Surface, *Volume, *Carbon dioxide, *Aeration, *Nitrates, *Cultures, *Scenedesmus, *Subsurface waters, *Agriculture, *Wastes, Algae, Assay, Dissolved solids, Chemical analysis, Phosphates, Iron compounds, Hydrogen ion concentration, Alkalinity, California, Light intensity, Temperature, Ions, Spectrophotometry, Suspended load, Fluorescence, Sumps.
Identifiers: Stripping, Firebaugh Center (Calif), Scenedesmus quadricauda, Cell counts, Species determination, Absorbance, Coenobia, Swirling, Volatile solids.

A method of removing nitrate-nitrogen from subsurface agricultural drainage water--algae stripping--encourages algal growth, nitrate is converted to cellular materials, and algae separated from liquid phase by centrifugation, flocculation, etc. This water, high in dissolved salts, is not a complete media for Scenedesmus (the alga used) growth. Laboratory studies are conducted to determine nutrient additions necessary for optimum growth (and nitrogen removal). One experiment determined effect of flask size, surface/volume ratio, and type of mixing (including aeration and carbon dioxide addition). Surface/volume ratio showed maximum growth or nitrogen removal occurred in 250-milliliter flasks containing 125 milliliters of culture. Compressed air alone effected a similar growth rate as compressed air enriched with carbon dioxide, neither additive affecting ultimate yield. In the agricultural drainage water used, carbon was probably a limiting element and rate of exchange across the surface of the culture was not sufficiently rapid with swirling only. The 7.3 - 7.6 pH range difference affected nutrient availability. In determining optimum amount of iron and phosphorus for nitrogen removal, type of mixing was significant. Measurement of the nitrate parameter by the specific ion electrode method can produce a rapid and reliable estimate of algal activity. (See Vol. 3, no. 7, Field 5C, entry W70-02775). (Jones-Wisconsin)
W70-03334

A COMPREHENSIVE APPROACH TO THE MANAGEMENT OF PHOSPHATES,
Chicago Univ., Ill. Center for Urban Studies; and Bauer Engineering, Inc., Chicago, Ill.
John R. Sheaffer, Fred Roland, and Wayne Cowlishaw.

To be available also in US Congress, House Committee on Government Operations, Sub-Comm on Conservation and Natural Resources, hearings on phosphate based detergents, Dec 16-17, 1969, Wash, DC, 1970. A statement before the Conservation and Natural Resources Subcommittee of the House Committee on Government Operations on matters relating to the hearings on Phosphate-based Detergents, Dec 16-17, 1969. 15p.

Descriptors: *Water quality, *Phosphates, *Waste water treatment, Biochemical oxygen demand, Nitrates, Water pollution sources, Fertilizers, Waste storage, Aerobic treatment, Settling basins, Soil disposal fields.
Identifiers: Muskegon County (Mich).

The management of phosphates and water quality needs to utilize a comprehensive approach to waste water management. Past efforts at waste water management have been characterized by disjointed incrementalism, i.e., many different governmental bodies become involved in water quality control, decentralizing and weakening the total program. A new approach to waste water management is based on three underlying concepts. They are: first, pollutants are resources out of place; two, waste water management systems must be designed as closed systems; and third, the environment is a total entity. A waste water management plan is outlined based on a plan developed for Muskegon County, Michigan. This plan proposes the use of waste water for irrigation purposes on nutrient deficient soils. Waste water is transported from an urban area to a location with suitable environmental geologic condition where a lagoon system provides for aeration to satisfy biological oxygen demand, settling to remove settleable solids, aerobic bacteria to consume soluble organic wastes, and photosynthetic cells to convert nitrates and phosphates into algal cell material that can be retained by the soil. After treatment in the lagoon system, the waste water is applied to geologically suited land areas, turning previously unproductive land into valuable cropland. (David-Chicago)
W70-03346

FOAM SEPARATION OF KRAFT PULPING WASTES.
Georgia Kraft Co., Rome. Research and Development Center.

FWPCA Grant No WPRD 117-01-68. Available from the Clearinghouse as PB-189 160, $3.00 in paper copy, $0.65 in microfiche. FWPCA Water Pollution Control Research Series, DAST-3, Oct 1969. 81 p, 2 tab, 14 fig, 28 ref, 5 append. FWPCA Program No 12040 EUG.

Descriptors: *Foam separation, *Pulping wastes, *B.O.D. removal, Tall oil removal, *Foaming reduction, *Solids removal, Treatment costs.

Laboratory studies of foam separation were conducted to determine the feasibility of this process for reducing B.O.D., solids content, and foaming tendency of clarified kraft mill effluent. Since kraft pulping wastes have a natural tendency to foam, it was expected that the foaming process, which has been found to be useful in treating domestic wastes, might have applications in treatment of these effluents. Both continuous flow and batch experiments were conducted, and liquid and foam heights, liquid feed rates, air sparging rates, and temperature were varied over wide ranges. The B.O.D. reduction in the treated liquid was disappointingly small, averaging less than 5 per cent, and the B.O.D. enrichment in the foam phase was in most cases less than 1.5 times that of the feed. Solids removal was correspondingly low. Foaming tendency, however, was significantly reduced by the intentional foaming process with reductions of 40 to 60 per cent in this variable being obtained. The reduction in foaming tendency was a strong function of gas-to-liquid ratio with the most effective operating range being between 1.0 and 1.5 SCFM/gallon. The experimental results suggest that the reductions in B.O.D. and foaming tendency were related to the separation of the tall oil

components of the waste. These components were concentrated in the foam fraction, but they accounted for a maximum of only 10 to 12 per cent of the B.O.D. of the raw feed. Apparently the remaining B.O.D.-producing materials were not surface active and did not attach themselves to the surface-active components. The cost of using a foam process on kraft mill wastes is estimated to be four to five cents per 1000 gallons of feed; this cost is exclusive of further processing of the concentrated foamate. Based on control of foaming tendency alone, the process would be unattractive from a cost standpoint.
W70-03350

FILTRATION OF ACTIVATED SLUDGE SECONDARY EFFLUENTS THROUGH SAND AND ANTHRACITE-SAND BEDS,
Wisconsin Univ., Madison. Water Resources Center.
Y. Misaka, and L. B. Polkowski.
Available from the Clearinghouse as PB-189 162, $3.00 in paper copy, $0.65 in microfiche. Wisconsin Water Resources Center, Technical Report OWRR A-006-Wis, June 1969. 198 p, 60 ref, 8 append. OWRR Project A-006-WIS.

Descriptors: *Flocculation, *Filtration, *Activated sludge, *Anthracite, Organic matter, Reclaimed water, Regressional analysis, Water pollution treatment, Protozoa.
Identifiers: *Sewage treated effluent, *Advanced waste treatment, *Sand, Filter backwashing, Experimental design.

Laboratory filtration studies were conducted on treated sewage effluent from a pilot activated sludge plant operated to provide effluent and mixed liquid solids for use in the experiments. The filtration media used were sand and a combination of anthracite and sand layers. To evaluate the filtration performance, statistical methods of experimental design and data analysis were applied. The major parameters varied for the experimental runs were flow rate, suspended particle size, suspended solid concentration, size of sand, size of anthracite, and depth of anthracite. Evaluation of filter performance was based on the amount of water produced per filtration run with an acceptable quality of filter effluent. Filtration performance ranged from 78 to 2430 gal/sq. ft. surface area for sand beds and from 488 to 4218 gal/sq. ft. for anthracite-sand beds. The concentration of the suspended solids in the influent applied was the most influential factor affecting performance and size of the top layer was the second most important factor as determined by regression analysis. Particle size of suspended solid applied was the third most important variable in terms of effect on performance when media size increased. The strength of the floc used was classified as 'strong' according to Hudson's breakthrough index. (Kerrigan-Wisconsin)
W70-03353

CURRENT PRACTICE IN POTATO PROCESSING WASTE TREATMENT,
Washington Univ., Seattle. Dept. of Civil Engineering.
Kristian Guttormsen, and Dale A. Carlson.
Available from the Clearinghouse as PB-189 232, $3.00 in paper copy, $0.65 in microfiche. Federal Water Pollution Control Administration Research Series Report DAST-14, Oct 1969. 108 p, 14 fig, 15 tab, 103 ref, 3 append. FWPCA Grant No. WP-01486-01, Program 12060.

Descriptors: *Waste treatment, *Potatoes, *Water pollution control, *Industrial wastes, Sewage treatment, Water reuse, Reclaimed water, Tertiary treatment, Lagoons, Spray irrigation, Filtration, Oxidation lagoons, Bibliographies, Costs, Byproducts
Identifiers: Potato waste treatment.

Potato processing, waste treatment, and current and needed research in water quality control in this production field are discussed. A brief discription is given of general characteristics of the potato and the effects and importance of cultural and environmental conditions on potato processing. General descriptions of the production processes are included and the literature is extensively reviewed to present current and proposed waste treatment technology. The most urgent research needs are discussed together with suggested methods for meeting these needs. (Knapp-USGS)
W70-03433

POLLUTION ABATEMENT BY MORE EFFECTIVE LIGNIN UTILIZATION: GRAFTING TO LIGNIN AND LIGNIN-CONTAINING PULPS,
North Carolina State Univ., Raleigh. Dept. of Chemical Engineering.
For primary bibliographic entry see Field 05G.
W70-03438

DISPOSAL OF WASTES FROM WATER TREATMENT PLANTS - PART 4,
American Water Works Association, New York.
For primary bibliographic entry see Field 05E.
W70-03442

BIODEGRADABLE DETERGENTS: RECENT PROBLEMS AND PROGRESS.

Textile Manufacturer, Vol 91, p 472-473, Nov 1965.

Descriptors: *Detergents, *Biodegradation, *Surfactants, *Foaming, *Biochemical oxygen demand, Soaps, Treatment facilities.
Identifiers: Alkyli benzene sulfonates, Textile wastes.

Principal synthetic detergents or 'surfactants' are the sodium salts of alkyl benzine sulphonates. When made from branched hydrocarbon chains of 12-15 carbon atoms, the detergent is 'hard' and is only 50% biodegradable in sewage. Foam accumulation in sewage facilities results, and in river water one month is required for 75% detergent decomposition. Detergents with straight hydrocarbon chains, 'soft' detergents, are biodegradable 'to a much greater extent' than the 'hard', but cause a rise in sewage biological oxygen demand. 'Soft' detergents can be made using the Ziegler technique of catalytic polymerization of ethylene. (Sheffield-North Carolina State)
W70-03530

AN INDUSTRIAL WASTE GUIDE TO THE WOOL PROCESSING INDUSTRY.

American Dyestuff Report, Vol 44, p 655-661, 1955. 58 ref.

Descriptors: *Domestic wastes, *Biochemical oxygen demand, *Biological treatment, Water pollution effects, Waste treatment, Toxicity, Alkalinity, Detergents, Coagulation, Chemical precipitation, Biodegradation.
Identifiers: *Wool, *Dyeing wastes, *Scouring waste, Textile wastes, Fiber wastes, Recovery (Waste), Acid dyes, Wool grease.

Waste composition from an individual woolen mill is determined by the processing steps performed in the plant. Wool-scouring wastes are the strongest pollutants. Significant polluting characteristics of woolen wastes include a rise in oxygen demand, suspended solids, acidity, alkalinity, color and grease. Undesirable odor also occurs. When discharged into a stream, these deplete oxygen, change the stream's physical properties, and are toxic to stream life. Four steps in dealing with a waste problem are (1) waste saving (economy and substitution), (2) byproduct recovery, (3) combined treatment with municipal sewage, and (4) treatment of residual waste. The quality of final plant effluent depends on state and local regulations based on stream condition and use. (Sheffield-North Carolina State)
W70-03531

'AN ANSWER TO STREAM POLLUTION'-STREAM POLLUTION REDUCTION PROGRAM FOR FINISHING PLANT.

Textile Industries, Vol 121, No 7, p 71-73, 1957. 1 map, 1 fig.

Descriptors. *Treatment facilities, *Biochemical oxygen demand, Waste treatment, Economics, Activated sludge, Toxicity, Flow rates, Fish.
Identifiers: *Bleaching wastes, *Finishing wastes, Starch, Dyeing wastes.

The Hohokus Bleachery, Inc., using a new biological-type effluent-treatment plant, eliminates the oxygen depletion, discoloration, and odor caused by wastes in its discharge stream. Concentrated dyewaste residues are collected and removed from the premises, leaving bleaching and finishing wastes (peroxides and starches) for treatment. Before operation begins, the two aeration tanks are seeded with microorganisms, and sources of nitrogen and phosphorus for the biological processes are added. Raw waste is fed across the length of the tanks at a rate of two cubic feet/minute, allowing microorganisms to grow up to equilibrium. Compressed air enters the tank at a rate of 200 cubic feet/minute. In quiescent tanks, sludge settles out and clear effluent flows through a weir into the stream. The two tanks treat a total of 44,000 gallons/day, removing about 1,000 pounds of oxidizable material. The process requires no neutralization of waste before treatment and produces effluent of pH 7.9-8.3. The plant cost is one-third that of conventional plants, and maintenance-process control requires one man-hour/day. (Sheffield-North Carolina State)
W70-03537

THERMAL-HYDRAULIC STUDY - ARKANSAS COOLING RESERVOIR,
Bechtel Corp., San Francisco, Calif.
H. S. Riesbol, J. B. Anderson, F. H. Wend, and H. T. Holmes.
ASCE National Water Resource Meeting, Memphis, Tennessee, Jan 26-30, 1970. Preprint, 43 p, 17 fig, 9 ref.

Descriptors: *Cooling, *Reservoirs, *Heat transfer, *Heat balance, *Mixing, *Model studies, Arkansas, Thermal power plants, Nuclear power plants, Thermal pollution, Path of pollutants, Mathematical models, Hydraulic models, Diffusion, Turbulence, Jets.

The results are summarized of the analytical and thermal-hydraulic model investigations that were carried out to determine whether the plant heat load from an 850 megawatt nuclear power plant could be dissipated in Dardanelle Reservoir under Arkansas state-prescribed criteria and limitations. Based on the results of the analytical and thermal-hydraulic model investigations, it was shown that the plant heat load of 137.1 x 10gBtu/day can be dissipated in the reservoir. The analytical procedure employed yielded conservative temperature distribution patterns throughout the reservoir and demonstrated its potential, both as a basis for evaluation of thermal effects and as a tool for future refinement and development. The analytical procedure used was based on a turbulent-mixing mathematical model of a non-buoyant jet with an isothermal temperature. The results of the hydraulic and mathematical model studies were similar. Intake temperature was raised only about 1 deg F under critical conditions. (Novotny-Vanderbilt)
W70-03542

EFFECT OF ORGANIC WASTE AND COOLING WATER ON SELF-PURIFICATION OF WATERS,
Technische Hochschule, Aachen (West Germany).
For primary bibliographic entry see Field 05C.
W70-03547

THE EFFECTS OF IMPOUNDING RESERVOIRS ON RIVER WASTE ASSIMILATIVE CAPACITY,
Vanderbilt Univ., Nashville, Tenn. Dept. of Environmental and Water Resources Engineering.
For primary bibliographic entry see Field 05C.
W70-03550

EVALUATION OF OPERATING PARAMETERS OF ALUMINA COLUMNS FOR THE SELECTIVE REMOVAL OF PHOSPHORUS FROM WASTEWATERS AND THE ULTIMATE DISPOSAL OF PHOSPHORUS AS CALCIUM PHOSPHATE,
Battelle-Northwest, Richland, Wash.
L. L. Ames.
Available from the Clearinghouse as PB-189 405, $3.00 in paper copy, $0.65 in microfiche. Robert A. Taft Water Research Center Report No TWRC-8, Cincinnati, Ohio, Mar 1969. 33 p, 17 fig, 5 tab, 19 ref. FWPCA Program 17010, Contract No 14-12-413.

Descriptors: *Filtration, *Tertiaryy treatment, *Phosphates, Sewage treatment, Nutrients, Separation techniques, Adsorption, Anion adsorption, Cation adsorption, Surfaces.
Identifiers: Phosphate removal, Alumina.

A synthetic secondary sewage effluent containing 10 to 30 mg/liter phosphate, 300 mg/liter bicarbonate, 112 mg/liter Cl and 50 mg/liter sulfate as anions and 130 mg/liter Na, 60 mg/liter Ca, 25 mg/liter each of K and Mg and 20 mg/liter ammonium as cations was used with 7.6 ml alumina columns to study the effects of various compositional changes on phosphorus removal. The phosphorus capacity was about half for the solution containing no Ca or Mg as compared to solutions containing them. Probably adsorption onto the alumina occurs partly as a calcium or magnesium phosphorus complex rather than as a simple phosphorus anion. Increasing the competing sulfate concentration in the influent solution to 4800 mg/liter showed little effect on phosphorus adsorption. Raising the pH of the synthetic sewage effluent to greater than 8.0 led to precipitation of calcium carbonate on the alumina grains which progressively lowered alumina phosphorus capacity. This problem was not encountered when using actual sewage effluent. It was found that alumina columns could be satisfactorily regenereated with NaOH. (Knapp-USGS)
W70-03612

OPTIMIZATION OF STEP AERATION WASTE TREATMENT SYSTEMS,
Kansas Water Resources Research Inst., Manhattan.
L. E. Erickson, and L. T. Fan.
Project Completion Report, (1969). 5 p, 8 ref, 2 append. OWRR Project No A-019-KAN.

Descriptors: *Activated sludge, *Hydraulic regime, *Mathematical modeling, *Optimization, *Mixing, Analysis, Design.
Identifiers: *Step aeration, Biological waste treatment.

This report summarizes work completed under a two year project on the optimization of step aeration waste treatment systems. Mathematical models of several step aeration systems were developed, process optimization studies were conducted, and the optimal step aeration and conventional treatment processes were compared.
W70-03614

SURFACE PROPERTIES OF TEFLON FILM IN SALINE WATER PROCESSES,
Nebraska Univ., Lincoln. Water Resources Research Inst.
For primary bibliographic entry see Field 03A.
W70-03646

5E. Ultimate Disposal of Wastes

ESTABLISHMENT OF TOWN SANITARY DISTRICTS.

Wis Stat Ann secs 60.305-60.315 (1957), as amended, (Supp 1969) 60.316 (Supp 1969).

Descriptors: *Wisconsin, *Administrative agencies, *Water works, *Waste disposal, Domestic wastes, Sewers, Sewage treatment, Sewage disposal, Storm drains, Surface drainage, Algal control, Aquatic life, Water conservation, Public health, Water pollution, Contracts, Regulation, Right-of-way, Estimated costs, Legal aspects, Legislation, Sewage districts.

The town sanitary district commissions are required to project, plan, construct, and maintain systems of water works and garbage or refuse disposal, including sanitary sewers, surface sewers, or storm water sewers. They are authorized to provide for sewage collection and the chemical treatment of water for control of nuisance producing aquatic growths. They are to undertake improvements for the promotion of public health. They may require the installation of private sewage systems. Charges for services and methods of financing construction are discussed. The Department of Resource Development may establish town sanitary districts in areas where it finds existing facilities inadequate and where a menace to health or pollution of surface waters exists. This determination by the Department is subject to judicial review. (Duss-Florida)
W70-03344

DISPOSAL OF WASTES FROM WATER TREATMENT PLANTS - PART 4,
American Water Works Association, New York.
Harry A. Faber, and Kitty C. Klomp.
Journal of American Water Works Association, Vol 62, No 1, p 63-70, Jan 1970. 8 p, 113 ref. FWPCA Grant 12120.

Descriptors: *Waste disposal, *Water treatment, Waste dilution, Disposal, Mixing, Waste treatment, Water quality control, Water pollution control, Treatment facilities, Separation techniques.
Identifiers: Water treatment plant wastes.

Current information on the nature of the water treatment plant waste disposal problem is summarized to assist water utilities in solving the problem. Technology presently available is described, new approaches to the problem are discussed and future directions for the coordination and dissemination of information are suggested. (Knapp-USGS)
W70-03442

EVALUATION OF OPERATING PARAMETERS OF ALUMINA COLUMNS FOR THE SELECTIVE REMOVAL OF PHOSPHORUS FROM WASTEWATERS AND THE ULTIMATE DISPOSAL OF PHOSPHORUS AS CALCIUM PHOSPHATE,
Battelle-Northwest, Richland, Wash.
For primary bibliographic entry see Field 05D.
W70-03612

5F. Water Treatment and Quality Alteration

RESEARCH ON TASTES AND ODORS,
A. A. Rosen.
Journal of American Water Works Association, Vol 62, No 1, p 59-62, Jan 1970. 4 p, 3 fig, 30 ref.

Descriptors: *Water quality, *Odor, *Taste, Biological properties, Potable water, Water pollution effects, Water properties, Laboratory tests, Water chemistry.
Identifiers: Water odor testing, Water taste testing.

Essentially all research on taste and odor in water is centered on the problems of odor. The most important progress has been made in the development of investigational techniques in an understanding of the role of specific industrial and natural organic chemicals in causing objectionable odors in water. Two of the most important natural odorants, metabolites of microorganisms, have been isolated and identified, or at least characterized in great detail. This identification is leading to more systematic water treatment, consisting of the use of tailor-made processes for the removal of specific odor contaminants. Sensory methods for the measurement and characterization of water odors are less actively investigated and have made relatively little progress in recent years. (Knapp-USGS)
W70-03440

HEALTH: WATER, SEWAGE, GARBAGE.

SC Code Ann secs 32-1201 thru 32-1335 (1962), as amended, (Supp 1968).

Descriptors: *South Carolina, *Sewage, *Septic tanks, *Water pollution, Water supply, Watershed management, Water sources, Environmental sanitation, Sewage disposal, Sanitary engineering, Streams, Waste disposal, Local governments, Administrative agencies, Water quality control, Inspection, Water pollution sources, Potable water, Domestic wastes, Structural design, Permits, Construction, Maintenance, Legislation, Legal aspects, Regulation, Watersheds (Basins).
Identifiers: *Garbage disposal, *Penalties (Criminal), *Privies.

To insure compliance with established water quality standards, all public or quasi-public water supplies must be periodically analyzed and the results reported to the State Board of Health. The Board shall also examine and inspect watersheds and water supplies and may publicize their findings. Construction permits issued by the Board are required for construction or modification of any public water treatment facilities or distribution systems. Provisions are made for protecting the water supply and regulating the sewer systems of Greenville County. The location and sanitation of privies located on watersheds of public water supplies are restricted. Manufacturing concerns which provide housing for their employees must include adequate sewage closet facilities. Requirements and regulations are established for the use of septic tanks in counties having cities with a population of seventy thousand or more. Special regulations are provided for septic tanks, garbage disposal, plumbing, sewage disposal, and the like on Pawley's Island and in Spartenburg County. Special permits are required for constructing or servicing any septic tank or other sewage disposal systems in Aiken County. (Dearing-Florida)
W70-03629

HEALTH: WATER, SEWAGE, GARBAGE (WATER SUPPLIES - WATER SUPPLY OF GREENVILLE).

SC Code Ann secs 32-1201 thru 32-1213 (1962), as amended, (Supp 1968).

Descriptors: *South Carolina, *Water supply, *Water works, *Water pollution, Water treatment, Water storage, Water distribution, Public health, Potable water, Permits, Administrative agencies, Standards, Engineering, Inspection, Bacteria, Chemical analysis, Water analysis, Testing, Water sources, Watershed management, Water pollution sources, Water conveyance, Dams, Legal aspects, Legislation, Regulation.
Identifiers: *Penalties (Criminal).

Permits from the State Board of Health are required for construction or modification of any

public or semi-public water treatment facility or water distribution system. The Board shall establish regulations and standards for the operation of waterworks systems and must inspect and approve any such facility before it begins operation. All public and semi-public water systems must be maintained in compliance with bacteriological and chemical water quality standards established by the Board. Every such water supply shall be periodically tested by the Board. The Board may enter and inspect all watersheds and water systems and may publish its findings. It is unlawful to: (1) trespass upon or deposit excreta in any source of public water supply or on the watershed of Greenville; (2) camp, hunt, fish, bathe, or wash in these sources or this watershed; (3) pasture any pigs or hogs or leave the carcas of any dead bird or animal on this watershed; (4) stop any vehicle unnecessarily or deposit any matter on any road within this watershed; or (5) destroy any water conductor of the Greenville water supply. Penalties are provided for failure to comply with these provisions. (Dearing-Florida)
W70-03630

HEALTH: WATER, SEWAGE, GARBAGE (PRIVIES, SEWAGE SYSTEMS, SEPTIC TANKS).

SC Code Ann secs 32-1221 thru 32-1270 (1962), as amended, (Supp 1968).

Descriptors: *South Carolina, *Septic tanks, *Watersheds (Basins), *Water sources, Environmental sanitation, Administrative agencies, Domestic wastes, Sewage disposal, Inspection, Legal aspects, Sewage, Construction, Installation, Maintenance, Engineering, Storage capacity, Structural design, Sanitary engineering, Waste water disposal, Effluents, Construction materials, Streams, Discharge, Pipes, Legislation.
Identifiers: Water closets.

All privies located on the watershed of any public surface water supply or within a specified distance from any house must be sanitarily maintained by designated persons in the manner prescribed by the State Board of Health. Sanitation inspectors designated by the Board may enter any premises for the purposes of inspection and may close any privy improperly maintained or constructed. Housing furnished to manufacturing employees by their employers must include properly constructed and maintained sewage closets. Sanitation of these closets and sewage connections is supervised by the Board. The State Board of Health shall establish specifications for septic tanks in counties which contain cities with a population greater than seventy thousand. These specifications shall incorporate statutory standards as to size, shape, liquid capacity, liquid depth, and detention period. Tanks with a capacity of one thousand gallons must be approved by the county health officer. Further regulations concern installation, construction materials, use of grease traps, distribution pipes and temporary tanks. No septic tank effluent may be discharged into any stream without approval from the county health officer. Penalties are provided for noncompliance with these provisions. (Dearing-Florida)
W70-03631

HEALTH: WATER, SEWAGE, GARBAGE (PAWLEY'S ISLAND, GREENVILLE COUNTY, SPARTENBURG COUNTY, AIKEN COUNTY).

SC Code Ann secs 32-1272 thru 32-1335 (1962), as amended, (Supp 1968).

Descriptors: *South Carolina, *Septic tanks, *Sewage disposal, *Domestic wastes, Permits, Administrative agencies, Construction, Sanitary engineering, Maintenance, Waste disposal, Water pollution sources, Streams, Rivers, Oceans, Construction materials, Tile drains, Plumbing, Potable water, Inspection, Warning systems, Legal aspects, Sewers, Water quality, Water quality control, Legislation.
Identifiers: *Toilets, *Tile fields, *Urinals, Slop sinks

No person may install or service a septic tank or other sewage disposal system in Aiken County without a permit from the governing body of that county. General regulations for garbage collection and disposal are provided. The State Board of Health shall regulate all sewers and septic tanks on Pawley's Island. No garbage, raw sewage, or drainage from any tile field may be deposited or discharged into the ocean, creeks, rivers, or marshes in the Pawley's Island area. All hotels, restaurants, inns, and boarding houses must provide safe drinking water and proper toilet facilities. Warning signs placed on unsafe facilities may not be tampered with. Adequate sewage facilities must be installed on premises where people reside or are employed in Greenville County. The Spartenburg County Board of Health shall regulate the quality of water supplies, sewage and garbage disposal, and commercial septic cleaning service in that county. The County Board shall require licenses for garbage collection and commercial septic tank services. (Dearing-Florida)
W70-03632

5G. Water Quality Control

THE MANAGEMENT AND CONTROL OF WATER IN PUERTO RICO,
Puerto Rico Univ., Mayaguez. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 04A.
W70-03246

POSSIBILITIES FOR MINERALIZATION OF PESTICIDES (DUTCH),
J. K. Baars.
H2O, Vol 2, No 17, p 398-39, Aug 21, 1969. 2 p, 1 fig, 1 tab.

Descriptors: *Pesticide residues, *Pesticide Kinetics, *Adsorption, Path of pollutants, Pesticide toxicity, Translocation, Biodegradation, Pesticide removal, Water quality control.
Identifiers: Mineralization of pesticides.

The increasing use of pesticides with a high persistence under natural conditions creates a problem with great consequences. Although these components may disappear from their dissolved state for example by adsorption to rivermud or accumulation in vegetable material or animal tissue, it does not mean a general decrease in concentration. Only complete mineralization would really mean elimination. The molecular structure is the reason of this high persistence. Chlorinated hydrocarbons, such as aldrin, hexachlor, dieldrin, heptachlorepoxyde are an example of this. Compounds like parathion and diuron, although very toxic, can be considered as rather soft. The chlorinated compounds cannot be mineralized aerobically. Recently it has been shown that some of them can be broken down anaerobically. Persistent also under anaerobic conditions, were heptachlorepoxyde and dieldrin. The consequence of this is the necessity of research for substitutes that are degradable, which also gave the solution in the case of the hard detergents. (Knapp-USGS)
W70-03271

CONTROL OF BLUE-GREEN ALGAE BLOOMS WITH 2,3-DICHLORONAPHTHOQUINONE,
Wisconsin Univ., Madison. Dept. of Botany.
George P. Fitzgerald, and Folke Skoog.
Sewage and Industrial Wastes, Vol 26, No 9, p 1136-1140, Sept 1954. 1 fig, 1 ref.

Descriptors: *Algicides, *Cyanophyta, *Eutrophication, Wisconsin, Water quality control, Lakes, Water pollution sources, Chlorophyta, Nuisance algae, Fish, Zooplankton, Snails, Application methods.
Identifiers: *2,3-dichloronaphthoquinone, Microcystis, Aphanizomenon, Anabaena, Gloeotrichia, Janesville (Wis), Spaulding's Pond (Wis), Hydrodictyon, Najas, Anacharis, Lake Waubesa (Wis), Macrophytes, Algal growth.

Methods for application of the selective algicide 2,3-dichloronaphthoquinone (2,3-CNQ) and results of a large-scale test of its effectiveness in controlling excessive growths of cyanophytes (blue-green algae) in Spaulding's Pond, Wisconsin are reported. This highly eutrophic lake of 27 acres normally supports a continuous bloom of algae, principally Microcystis and Alphanizomenon, during summer. Spray applications of 2,3-CNQ suspensions, yielding concentrations of 30-55 parts per billion in the lake, clumped and killed heavy growths of cyanophytes. Such chemical treatment had no observable harmful effects on chlorophytes (green algae), higher aquatic plants, fish, or zooplankton. Some instances of rapidly recurring cyanophyte blooms required repeated applications. Lasting effects of treatment with 2,3-CNQ may be indirectly increased as a result of vigorous growth of chlorophytes and macrophytes which follows suppression of cyanophytes. (Eichhorn-Wisconsin)
W70-03310

PUBLIC HEALTH, POLLUTION CONTROL, AND PROTECTION OF NATURAL RESOURCES.

Wis Stat Ann secs 144.21-144.30 (Supp 1969).

Descriptors: *Wisconsin, *Treatment facilities, *Pollution abatement, *Project planning, Administrative agencies, Water pollution control, Water conservation, Natural resources, Wildlife conservation, Public health, Shoreline cover, Cities, Navigable waters, Lakes, Lake Superior, Lake Michigan, Fish, Aquatic animals, Environmental sanitation, Rivers, Domestic wastes, Standards, Regulation, Waste disposal, Financing, Beds, Waste treatment, Water treatment, Water quality, Water utilization.
Identifiers: *Air contaminant, *Emission.

A state program is created for financial assistance to municipalities in the construction of pollution prevention and abatement facilities. The types of activities to be financed by the program include preliminary planning, actual construction, and supervision of the anti-pollution facilities. Methods of financing and cost sharing between the state and municipalities are outlined. The Department of Resource Development, in cooperation with an advisory subcommittee and municipalities, is empowered to protect navigable waters. This plan is designed to promote healthful conditions, to prevent and control water pollution, to protect spawning grounds and aquatic life, to control placement of structures and land uses, and to preserve shore cover and natural beauty. The Department is to prepare a comprehensive plan to guide municipalities in regulating navigable waters and adjacent shorelands. Water use priorities governing the plan are listed in the statute. 'Solid waste' is defined to include garbage, refuse, and other discarded or salvageable solid materials; the term does not include solids or waste materials in waste water effluents or other common water pollutants. (Duss-Florida)
W70-03345

FOAM SEPARATION OF KRAFT PULPING WASTES.
Georgia Kraft Co., Rome. Research and Development Center.
For primary bibliographic entry see Field 05D.
W70-03350

NEUTRON ACTIVATION ANALYSIS IN WATER RESOURCES MANAGEMENT IN NORTH CAROLINA,
North Carolina Water Resources Research Inst., Raleigh.
For primary bibliographic entry see Field 05A.
W70-03351

FILTRATION OF ACTIVATED SLUDGE SECONDARY EFFLUENTS THROUGH SAND AND ANTHRACITE-SAND BEDS,
Wisconsin Univ., Madison. Water Resources Center.

For primary bibliographic entry see Field 05D.
W70-03353

CLEANING OUR ENVIRONMENT--THE CHEMICAL BASIS FOR ACTION.

Chem Eng News, Vol 47, No 38, p 58-69, Sept 1969. 12 p.

Descriptors: *Environment, *Water pollution, *Cleaning, *Pollution abatement, Water pollution, Air pollution, Pesticides, Air pollution effects, Pollutants, Water pollution effects, Water pollution sources, Chemical engineering, Chemistry, Motor vehicles, Municipal wastes, Tertiary treatment, Public health, Solid wastes, Contamination, Ecology.
Identifiers: *Air pollution control, *Pollution control.

A summary and recommendations from the report of the subcommittee on environmental improvement of the ACS Committee on Chemistry and Public Affairs, presented at the American Chemical Society national meeting in New York City in Sept 1969, are given. The subcommittee had 2 goals: (1) to give an objective account of the current status of the science and technology of environmental improvement--what is known, how it is being used, what must be learned, and how it might be used; and (2) to analyze the information and recommend measures that, if adopted, should help to accelerate the sound development and use of that science and technology. A strong emphasis is placed on chemistry, chemical engineering, and the related disciplines. The full report contains 73 recommendations found in 4 principal divisions of the report: air environment, water environment, solid wastes, and pesticides in the environment. (USBR)
W70-03364

REPORT OF COMMITTEE ON POLLUTION.

Proceedings of the 56th Annual Convention Nat'l Rivers and Harbors Congress, p 8-13, May 13-15 1969. 6 p.

Descriptors: *Water pollution control, *Financing, *River basins, *Education, Water pollution, Water policy, Water quality, Water quality control, Water pollution sources, Pollution abatement, Pollutant identification, Pollutants, Saltation, Administrative agencies, Regulation, Waste treatment, Treatment facilities, Sedimentation, Sediments, Erosion, Erosion control, Coordination, River basin development.
Identifiers: National Rivers and Harbors Congress.

The general breakdown in pollution control appears to be lack of adequate funding at local, state, and federal levels. More public education concerning pollution is needed. Water storage for pollution abatement should be given the same weight in evaluation as other uses. A river basin approach to total problem solution is generally a sound basis of operation. The saltation problem should attract cooperation and support from more than just agricultural agencies. At this time the application of existing research results is more needed than additional research. A public information and education program should be a first priority. The water quality management program should use locally-oriented, cooperative efforts governed by standardized state and federal regulations. Land management practices should benefit soil conservation as well as water quality control. Approved standards must be implemented in water quality and quantity control measures. A lack of awareness, a poor attitude, and apathy are the greatest deterrents to pollution control. Erosion and other sediment sources are a major source of pollution and must be controlled. (Smith-Florida)
W70-03378

ENVIRONMENTAL LAW CONFERENCE PROPOSES NATIONAL LEGAL ACTION--INFORMATION CENTER.

Conservation Foundation Letter 9-69, p 1-11, Sept 30, 1969.

Descriptors: *Conservation, *Conferences, *Legal aspects, Public rights, Publications, Competing uses, Condemnation, Eminent domain, Legislation, Water conservation, Resources, Pollution abatement, Air pollution, Water pollution, Water pollution control, Water pollution effects, Cost-benefit ratio, Cost allocation.

A conference on law and environment in September, 1969, considered problems concerning the preservation of environment. Recommendations made to help the legal profession become more involved in the struggle for environmental quality included: (1) creation of an environmental law center and environmental law publication; (2) expansion of law school programs in environmental law; and (3) the encouragement by bar associations of greater interest in environmental law. Legal methods of eliminating influences destructive to the environment include abatement of nuisances and the use of the trust doctrine, which impresses a trust upon the state to preserve public and private lands for the benefit of the public. The opinion was expressed that the courts are ahead of legislatures in solving environmental problems. The difficulties previously encountered by private citizens in establishing standing in court to challenge public officials were said to be lessening. Other problems of private litigation discussed included the burden of proving environmental damage, the social utility of litigation, and expenses of suit. A specific topic discussed was the Santa Barbara oil spill. Expense of private suits in such cases was decided to the prohibitively high. (Dye-Florida)
W70-03379

LAND AND WATER CONSERVATION FUND ACT.
For primary bibliographic entry see Field 06B.
W70-03390

LAND AND WATER CONSERVATION FUND ACT (DEPARTMENT OF INTERIOR).
For primary bibliographic entry see Field 06B.
W70-03391

LAND AND WATER CONSERVATION FUND ACT (DEPARTMENT OF AGRICULTURE).
For primary bibliographic entry see Field 06B.
W70-03392

LAND AND WATER CONSERVATION FUND ACT (THE APPALACHIAN REGIONAL COMMISSION, TENNESSEE VALLEY AUTHORITY, THE WATER RESOURCES COUNCIL, AND CERTAIN DEPARTMENTS).
For primary bibliographic entry see Field 06B.
W70-03394

POWERS OF THE WATER POLLUTION CONTROL BOARD.
Ohio Rev Code Ann secs 6111.01 thru 6111.05, 6111.07, 6111.08 (Page 1953), as amended, (Supp 1970).

Descriptors: *Ohio, *Water pollution, *Water pollution control, *Sanitary engineering, Legislation, Legal aspects, Sewage, Sewage disposal, Domestic wastes, Industrial wastes, Municipal wastes, Water resources development, Streams, Rivers, Lakes, Drainage, Drainage districts, Water pollution treatment, Pollution abatement, Public health, Waste treatment, Waste disposal, Federal government, State governments, Administrative agencies.

A Water Pollution Control Board is established within the Department of Health for the prevention, control, and abatement of water pollution. The Board is granted the power: to develop plans; to conduct research; to join in cooperative programs with other concerned agencies; to promulgate rules and regulations; to issue, revoke, or modify permits for the discharge of sewage and wastes; and to exercise all other incidental powers necessary to carry out the purposes of water pollution control. Pollution of the waters of the state is prohibited unless a permit is obtained from the Board. Procedures are established for the prosecution of violators. (Casey-Florida)
W70-03398

THE ORGANIZATION, PURPOSES, AND POWERS OF A SANITARY DISTRICT.
Ohio Rev Code Ann secs 6115.04, 6115.05, 6115.16 thru 6115.19 (Page 1953).

Descriptors: *Ohio, *Environmental sanitation, *Water policy, *Water supply, Legislation, Legal aspects, Water resources, Water pollution, Water resources development, Mosquitoes, Insect control, Domestic wastes, Public health, Streams, Sewage, Sewage districts, Streamflow, Channels, Construction, Watercourses, Drainage, Water purification, Taxes.

Upon petition in the manner prescribed by this statute, the court of common pleas of any county may establish within that county a sanitary district to prevent and control pollution, to regulate the flow of streams and channels for sanitary purposes, to provide for collection and disposal of sewage, garbage and other refuse, to provide a water supply, and to exterminate insects and destroy their breeding places. The board of directors of a sanitary district must secure approval of plans for improvement of the district. The board is authorized to enter upon private lands to carry out the purposes of the district. The board is not authorized to construct sewer systems for local service, but is limited to construction and maintenance of works necessary to improve district sanitation and water supply. (Casey-Florida)
W70-03399

DUTIES OF SANITARY DISTRICTS REGARDING POLLUTION, WATER SUPPLY, MOSQUITO CONTROL, AND INVESTIGATIONS OF RAINFALL AND STREAMFLOW.
Ohio Rev Code Ann secs 6115.23, 6115.24, 6115.26, 6115.27 (Page 1953).

Descriptors: *Ohio, *Environmental sanitation, *Water policy, *Water supply, Legislation, Legal aspects, Water resources, Sewage, Sewage districts, Water pollution, Water pollution control, Water utilization, Wastes, Mosquitoes, Public health, Federal government, Sewers, Streamflow, Rainfall, Drainage, Conservation, Water resources development, Insect control.

Authority is granted to the board of directors of each sanitary district to make and enforce regulations within the district regarding the design, construction and use of sewers; the uses and distribution of the water supply; the prevention of pollution or unnecessary waste of the water supply; the making of surveys and investigations of rainfall and streamflow; and the control, prevention, and elimination of mosquitoes and other insects, and their breeding places. Authority to cooperate with the federal government, the state government, and their agencies for these purposes is granted. Penalties for noncompliance with these regulations are established. (Casey-Florida)
W70-03400

WATERCRAFT; NAVIGATION.
For primary bibliographic entry see Field 06E.
W70-03408

OHIO VALLEY SANITATION COMPACT.
Tenn Code Ann secs 70-401 thru 70-409 (1956).

Descriptors: *Tennessee, *Interstate compacts, *River basin development, *Ohio River, Interstate rivers, Rivers, Streams, River basins, River basin commissions, Basins, Water resources development, Interstate commissions, Legislation, State governments, Administrative agencies, Navigable waters, Pollution abatement, Water pollution control, Standards, Water pollution treatment, Water pollution sources, Water pollution, Waste water treatment, Industrial wastes, Sewage.

The Governor is authorized to join the Ohio River Valley Water Sanitation Compact. The party states agree to cooperate in pollution control and abatement, to enact any legislation necessary for such purpose, and to maintain the Ohio River Basin's waters in a satisfactory sanitary condition. The Ohio River Valley Water Sanitation Commission and District are hereby created. It is recognized that no single standard for sewage treatment is applicable to all parts of the district, but pollution by sewage or industrial wastes shall not injuriously affect the various uses of the interstate waters of the basin. All sewage discharged into the basin shall be treated so as to remove all settleable solids and not less than forty-five percent of all suspended solids. All industrial wastes discharged into the basin shall be treated so as to protect the public health and preserve the waters for other legitimate purposes. The Commission may adopt regulations and standards for enforcing this article. The Commission shall make studies and recommendations to the party states. The Commission may order that the discharge of sewage or industrial wastes into interstate rivers be discontinued, modified or treated. (Smith-Florida)
W70-03415

TENNESSEE RIVER BASIN POLLUTION CONTROL.
Tenn Code Ann secs 70-1901 thru 70-1912 (Supp 1969).

Descriptors: *Tennessee, *Interstate compacts, *Water pollution, *Tennessee River, Interstate rivers, Legislation, Administrative agencies, Interstate commissions, River basin commissions, State governments, Pollution abatement, Water quality control, Standards, Sewage treatment, Waste treatment, Water utilization, Classification, Sewage, Industrial wastes, Judicial decisions, Administrative decisions, Financing.
Identifiers: *Tennessee River Basin.

The Tennessee River Basin Water Pollution Control Compact provides for the control and reduction of pollution in that area. A Commission is established to administer the Compact as an agency of each participating state. The Commission shall conduct surveys and make recommendations to the signatory states. Membership, administrative procedure, powers to deal with property, and the method of financing the Commission are provided. No single standard of sewage and waste treatment and no single standard of quality of receiving waters shall apply throughout the district. The standards established should reflect the present and proposed highest use of the waters. The Commission may establish interstate water quality standards for various classifications of use. Each signatory state will classify waters within its state upon approval by the Commission, and will establish programs for treatment of sewage and industrial wastes in accordance with these standards. The Commission, after investigation, notice and hearing, may recommend abatement action against reported polluters and may order polluting discharge by any municipality, corporation, person, or other entity to be discontinued. Any court of competent jurisdiction shall exercise its equitable powers to enforce and/or modify the order. (Dearing-Florida)
W70-03420

ECONOMIC EVALUATION OF WATER QUALITY, FINAL REPORT,
California Univ., Berkeley. Sanitary Engineering Research Lab
P. H. McGauhey, Jona Bargur, E. M. Lofting, and H. C. Davis.
Available from the Clearinghouse as PB-189 169, $3.00 in paper copy, $0.65 in microfiche. SERL Report No 69-8, Nov 1969. 117 p, 45 tab, 44 ref. FWPCA Program 16090DLU, (WP-00597-06).

Descriptors: *Economic evaluation, *Water quality, *Computer programs, Estuaries, *Input-output analysis, San Francisco Bay, *Mathematical models, Waste water treatment.
Identifiers: Water quality standards, *Systems analysis, Industrial effluents, Water management.

The tendency to set quality of the water resource rather than quality of discharges as the objective of environmental control makes it necessary to develop some relationship between concentration of individual pollutants in the resource and in the discharge in terms of characteristics of the receiving estuary. Moreover, the growing percentage of the water resource which is degraded in quality through beneficial use together with the increasing investment necessary to restore water quality, makes it important to minimize the cost of achieving water quality objectives. The study makes use of modern mathematical models, programming techniques, and input-output analysis to optimize quality control systems; and illustrates the use of the models by examples drawn from San Francisco Bay data and quality requirements.
W70-03428

POLLUTION ABATEMENT BY MORE EFFECTIVE LIGNIN UTILIZATION: GRAFTING TO LIGNIN AND LIGNIN-CONTAINING PULPS,
North Carolina State Univ., Raleigh. Dept. of Chemical Engineering.
R. B. Phillips, A. J. Kobayashi, W. Brown, and V. T. Stannett.
Available from the Clearinghouse as PB-189 292, $3.00 in paper copy, $0.65 in microfiche. Progress Report No 25, Water Resources Research Institute of The University of North Carolina, Jan 1970. 60 p. OWRR Project A-032-NC.

Descriptors: *Pulp wastes, *Lignins, *Industrial wastes, Water pollution control non-structural alternatives.

The problem of increased utilization of lignin has been approached from two directions: first, a procedure has been developed for grafting vinyl monomers to isolated lignin; second, grafting of hydrophilic monomers to pulps containing substantial amounts of lignin (high yield pulps) has been attempted. In the first case, styrene was successfully grafted by radiation to a commercially available lignin. In the more successful cases, the grafted product has the solubility behavior of polystyrene. While the reaction proceeds adequately in the presence of good swelling agents for the lignin, the expenditure of radiation is great (16 x 10 to the 6th power rads); on the other hand, grafting in the presence of large amounts of methanol speeds the reaction (3 x 4 x 10 to the 6th power rads), presumably because of a hindered radical termination rate. It was found that acrylamide could not be significantly grafted to unbleached kraft pulps containing even only 4% lignin. Consequently, a study was made of the strength properties of blends of highly grafted pure cellulose pulps and the ungrafted high yield kraft pulps. While the blends significantly improved the strength properties of the high yield pulp, the radiation involved and the amounts of the grafted pulp required were great, thus casting doubt on the economic feasibility of such a combination. (Howells-University of North Carolina)
W70-03438

PROCEEDINGS WORKSHOP ON WATER AND SEWER CHARGES AS RELATED TO WATER USE AND WASTE CONTROL.
North Carolina Water Resources Research Inst., Raleigh; North Carolina State Univ., Raleigh; and North Carolina Univ., Chapel Hill.
Available from the Clearinghouse as PB-189 289, $3.00 in paper copy, $0.65 in microfiche. Report No 30, David H. Howwells, (Ed), Water Resources Research Institute of The University of North Carolina, Oct 1, 1969. 120 p. OWRR Project A-999-NC.

Descriptors: *Municipal water, *Municipal wastes, *Industrial wastes, *Water rates, *Water pricing, Water demand, Water pollution control.
Identifiers: Sewer rates.

The objectives of this workshop were to: (1) assess current practices in setting water and sewer charges together with possible alternatives, (2) examine present and future objectives of municipal government in establishing water and sewer service charges, (3) consider the effect of water and sewer service charges on water use and waste disposal practices, and (4) review and discuss proposed research and extension activities related to water and sewer service charges. Participants included public works officials of North Carolina's larger cities, consulting engineers, university faculty and other interested persons. This is the third in a series of research workshops sponsored by the Institute to increase the communication between research users and researchers on water resource problems and research needs.
W70-03439

WATER AND MAN: A WORLD VIEW,
Geological Survey, Washington, D.C. Water Resources Div.
For primary bibliographic entry see Field 06G.
W70-03450

USE OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL STUDIES,
Northeastern Univ., Boston, Mass. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05B.
W70-03488

VACATION OR RELOCATION OF WATERCOURSES - CONSTRUCTION OF DAMS.
For primary bibliographic entry see Field 04A.
W70-03521

ACQUISITION OF LAND TO PREVENT CONTAMINATION.

Pa Stat Ann tit 53, sec 2992 (1957).

Descriptors: *Pennsylvania, *Condemnation, *Compensation, *Domestic water, Water pollution, Reservoirs, Pollution abatement, Cost repayment, Condemnation value, Public health, Water conservation, Streams, Local governments, Cities, Safety, Water quality, Legislation, Damages.

Any municipality, except third class cities, may acquire and hold lands which are contiguous to streams or reservoirs from which water is taken for public use when it is necessary to preserve the reservoirs from contamination. These lands may be acquired by purchase or condemnation. No land, however, shall be taken until just compensation has been made for property taken, injured, or destroyed. (Schram-Florida)
W70-03532

AUTHORITY OF CITIES TO DEVELOP SEWAGE SYSTEMS, AND TO IMPROVE LAKES AND WATERCOURSES.
Wis Stat Ann secs 62.18, 62.22 (1) (3), 62.23 (18) (1957).

Descriptors: *Wisconsin, *Cities, *Lake Michigan, *Riparian rights, Legislation, Legal aspects, Sewage treatment, Environmental sanitation, Waste treatment, Construction, Taxes, Government finance, Municipal waste, Lakes, Rivers, Streams, Navigable waters, Navigation, Natural resources, Public health, Condemnation, Sewage districts, Sewers.

Cities are given the authority to construct, maintain, and improve systems of sewerage, including sewage disposal plants, and may join in cooperative efforts with adjacent municipalities of a bordering state in these endeavors. Authority for surveys, plans, and construction of sewers and sewer districts is provided. A special sewer district tax power to finance these projects is granted. A city may take or destroy any riparian rights appurtenant to land abutting Lake Michigan whenever necessary for a public improvement. A city may improve lakes, rivers, and other navigable streams, where such improvements are in aid of navigation, or are for protection of public health and welfare, or wildlife. (Casey-Florida)
W70-03534

WATERWORKS AND SEWERAGE.
Wis Stat Ann secs 145.04 (1957), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Sewage disposal, *Municipal wastes, *Public health, Cities, Sewage, Waste water disposal, Water supply, Water tanks, Waterworks, Pipes, Plumbing, Inspection, Regulation, Utilities, Leakage, Buildings, Standards, Permits, Administrative agencies, State governments.
Identifiers: *Sanitary district.

Townships, counties, metropolitan sewerage commissions and certain cities may prescribe ordinances concerning waterworks and sewerage in order to safeguard public health. These are not to conflict with minimum standards for pipes, tanks, and fixtures by which fresh water, waste water, or sewage is carried. No such waterworks are to be placed in buildings except in accordance with plans approved by the Board of Public Works or Board of Health. No blumbing shall be done, except repairing leaks, without permit. No municipal sewerage commission or other agency shall require licensing of anyone licensed under this chapter or prohibit such person from doing business within the scope of his permit. Authorities of sewerage districts shall report the failure of any licensed plumber to qualify as a journeyman or master plumber to the State Board of Health. (Duss-Florida)
W70-03535

STREAMFLOW EFFECTS IN A STRATIFIED MODEL RESERVOIR,
Oregon State Univ., Corvallis.
For primary bibliographic entry see Field 08B.
W70-03543

MECHANICS OF STRATIFIED FLOW THROUGH ORIFICES,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
For primary bibliographic entry see Field 08B.
W70-03544

JET DIFFUSION, REVIEW OF MODEL TESTING AND COMPARISON WITH THEORY,
Chalmers Univ. of Technology, Goteborg (Sweden). Hydraulics Div.
For primary bibliographic entry see Field 08B.
W70-03555

LEGAL VIEWPOINT (WATER STANDARDS),
Frank E. Maloney.
Am Water Works Ass'n J, Vol 52, No 9, p 1180-88, Sept 1960. 9 p, 61 ref.

Descriptors: *Potable water, *Water policy, *Public health, *Water quality, Standards, Impaired water quality, Domestic water, Water law, Water quality control, Water supply, Florida, Cities, Administrative agencies, Federal government, Fluoridation, Water purification, Wastes, Water pollution, Water Quality Act, Legislation, Water requirements, Water treatment, Industrial use, Water works.
Identifiers: *Water quality standards.

Due to the endorsement by so many national organizations concerned with water supply and public health, the Drinking Water Standards of the USPHS have had a tremendous impact throughout the United States. Public health legislation, under the police power, has been enacted in many states - with the USPHS standards serving as guidelines. State boards of health have been generally utilized for implementing and maintaining these standards. Municipal corporations may also enact ordinances relating to water supply and purity. Generally, the courts have upheld these delegations of power when they are necessary for the protection of public health. Although the greatest area of litigation in this field has been with respect to fluoridation, no court has thus far prohibited it. Complying with the USPHS standards could be an effective means for minimizing the liability of water purveyors for negligence. Developments in the area of implied warranty suggest that liability may be extended to include water suppliers. A brief review of the law in these areas is included. Widespread respect for the USPHS standards seems to dictate that any drastic change be limited to prohibiting contaminants which can clearly be shown to pose a threat to the public health. (Schram-Florida)
W70-03561

OPINION OF THE JUSTICES (WATER AND SEWER DISTRICT LEGISLATION).
For primary bibliographic entry see Field 04A.
W70-03564

WATER DEVELOPMENT AUTHORITY.
For primary bibliographic entry see Field 06B.
W70-03575

WATER AND WATERWORKS COMPANIES.
For primary bibliographic entry see Field 06E.
W70-03587

MATHEMATICAL MODEL OF SEWAGE SLUDGE FLUIDIZED BED INCINERATOR CAPACITIES AND COSTS,
General American Transportation Corp., Niles, Ill.
G. J. Ducar, and P. Levin.
Available from the Clearinghouse as PB 189 295, $3.00 in paper copy, and $0.65 in microfiche. FWPCA Ohio Basin Region, Robert A. Taft Water Research Center, Report TWRC-10, Advanced Waste Treatment Research Laboratory, Cincinnati, Ohio - Sept 1969. 72 p, 4 tab, 32 fig, 57 ref. FWPCA Program 17090; FWPCA Contract 14-12-415.

Descriptors: *Mathematical models, Computer models, *Sewage sludge, Incineration, Sludge disposal, Evaluation, *Capital costs, *Operating costs, *Maintenance costs.
Identifiers: Fluidized bed incineration.

The development of a computer program to evaluate sewage sludge fluidized bed incineration systems is described. Data for the program was collected from manufactures, a literature survey and field trips to operating installations. Most of the data was obtained from the field because of the lack of available information from the other sources. More than fifty correlation relationships were attempted before the necessary data could be reasonably represented. Equations were developed for the least square curves which fitted the data best. These equations were used as the basis for the computer program developed to size some of the major components and to estimate capital, operating and maintenance costs for the fluidized bed incineration system.
W70-03610

OPTIMIZATION OF STEP AERATION WASTE TREATMENT SYSTEMS,
Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 05D.
W70-03614

AN ECONOMIC APPROACH TO REGIONAL INDUSTRIAL WASTE MANAGEMENT,
Clemson Univ., S.C. Dept. of Environmental Systems Engineering.
Benjamin C. Dysart, III.
Paper presented at 24th Purdue Ind Waste Conf, Purdue Univ, May 6-8, 1969. 24 p, 12 fig.

Descriptors: *Industrial wastes, *Economic efficiency, *Resource allocation, *Dynamic programming, *Water quality control, Dissolved oxygen, Planning, Management, Water utilization, Streams, Constraints, River basins.
Identifiers: Industrialized basin.

An economic approach to regional industrial waste management was presented. Two problem levels were considered; a resource allocation problem for which waste assimilative capacity was allocated to among competing users and the objective was economic efficiency with dissolved oxygen standards (DO) as constraints. The second problem level consisted of investigating the response on sensitivity of the minimum total system cost and the optimal management policy to system variation. A hypothetical river basin system consisting of three stream reaches or stayes in series with an industrial waste outfall located at the upstream end of each stage was used to illustrate the two problem levels. A dynamic programming technique was found to be useful in determining the minimum-cost management systems that met all constraints for a fixed system configuration. (Thiuri-Cornell)
W70-03619

AERATION OF STREAMS WITH AIR AND MOLECULAR OXYGEN,
Crown Zellerbach Corp., Camas, Wash.
H. R. Amberg, D. W. Wise, and T. R. Aspitarte.
Tappi (Technical Association of Pulp and Paper Industry), Vol 52, No 10, p 1866-71, Oct 1969. 6 tab, 5 fig, 7 ref.

Descriptors: *Aeration, *Dissolved oxygen, *Oxygen, Water quality control, Diffusion, Pollution control.
Identifiers: *Instream aeration.

Results are given on full scale river aeration by two methods (a) release of oxygen into hydroelectric turbines, and (b) diffusion of gaseous oxygen into water under pressure. Oxygen is approximately five times as effective as an equal quantity of air in imparting dissolved oxygen to streams. The authors consider that provided the oxygen is procured at $30 per ton dissolved oxygen can be added to the water at a total cost of 3 - 4 cents per pound. (Whipple-Rutgers)
W70-03625

CONSERVANCY DISTRICTS (WATER QUALITY MANAGEMENT AND PROTECTION).

Ohio Rev Code Ann secs 6101.13, 6101.15, 6101.19 (Page 1953), as amended, (Supp 1970).

Descriptors: *Ohio, *Administrative agencies, *Water pollution, *Water pollution treatment, Wastes, Liquid wastes, Water supply, Water utilization, Sewage, Sewage disposal, Sewage treatment, Ditches, Sewers, Drains, Rivers, Streams, Flow, Construction, Dams, Dikes, Sluices, Bridges, Water works, Treatment facilities, Supervisory control (Power), Cost analysis, Legislation, Legal aspects, Diversion.
Identifiers: *Conservancy districts, *Purification works, Penalties (Civil).

The board of directors of conservancy districts shall prepare plans for water improvements for their districts. Unless requested by the governing bodies of municipal corporations such plans shall not provide a water supply system or system for sewage disposal. The board of directors has supervisory control over the implementation of plans. In order to accomplish water quality and quantity control, a board may: alter any watercourse, ditch, sewer, river, or stream; fill up the same and divert

water flow; construct necessary structures for water control and waste treatment; and construct connections to works for the delivery of water supply or sewage. For these purposes, a board may also acquire, sell, or control real or personal property. A board may make such regulations as are necessary to protect improvements in conservancy districts. It may prescribe regulations for: construction of structures; the connection of sewers, ditches or pipelines with the works of a district; the permissible uses of the water supply; and the discharge of liquid and solid wastes into sewers. Persons violating such regulations shall be liable for their damage. (Duss-Florida)
W70-03644

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

A PARTICULAR STOCHASTIC PROCESS AS APPLIED TO HYDROLOGY,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-03301

RIVER RUNOFF AS A STOCHASTIC PROCESS, AND ITS MATHEMATICAL MODELLING,
Gruzinskii Politekhnicheskii Institut, Tiflis (USSR).
For primary bibliographic entry see Field 02A.
W70-03304

A STOCHASTIC CONSIDERATION ON VARIATION OF HYDROLOGIC QUANTITIES,
Kyoto Univ. (Japan). Disasters Prevention Research Inst.
For primary bibliographic entry see Field 02A.
W70-03305

ECONOMIC EVALUATION OF WATER QUALITY, FINAL REPORT,
California Univ., Berkeley. Sanitary Engineering Research Lab.
For primary bibliographic entry see Field 05G.
W70-03428

GENERALIZING DRY-DAY FREQUENCY DATA,
Agricultural Research Service, Beltsville, Md. Hydrograph Lab.
For primary bibliographic entry see Field 02B.
W70-03441

USE OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL STUDIES,
Northeastern Univ., Boston, Mass. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05B.
W70-03488

SIMULATION OF RUNOFF FOR DESIGN OF WATER RESOURCE SYSTEMS,
State Water Plan Development of Water Resources Management, Prague (Czechoslovakia).
For primary bibliographic entry see Field 02A.
W70-03496

STOCHASTIC DESCRIPTION OF DAILY RIVER FLOWS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-03497

RELIABILITY ESTIMATES FOR A STORAGE RESERVOIR WITH SEASONAL INPUT,
Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 04A.
W70-03498

MATHEMATICAL MODEL OF SEWAGE SLUDGE FLUIDIZED BED INCINERATOR CAPACITIES AND COSTS,
General American Transportation Corp., Niles, Ill
For primary bibliographic entry see Field 05G.
W70-03610

AN ECONOMIC APPROACH TO REGIONAL INDUSTRIAL WASTE MANAGEMENT,
Clemson Univ., S.C. Dept. of Environmental Systems Engineering.
For primary bibliographic entry see Field 05G.
W70-03619

6B. Evaluation Process

THE WATER RESOURCES SITUATION IN PUERTO RICO: AN EVALUATION OF PUBLISHED INFORMATION,
Puerto Rico Univ., Mayaguez. School of Engineering.
A. S. Vazquez, R. B. Ramgolam, H. Q. Vives, and A. R. Villanueva.
Available from the Clearinghouse as PB-189 156, $3.00 in paper copy, $0.65 in microfiche. Water Resources Research Institute Technical Completion Report, Puerto Rico University, Jan 1970. 188 p, 300 ref, 2 index, 1 append. OWRR Proj No A-012-PR.

Descriptors: *Bibliographies, *Abstracts, *Water resources, *Puerto Rico, Surface waters, Groundwater, Water utilization, Water management (Applied), Water resources development, Documentation, Planning, Water quality.
Identifiers: *Water resources bibliography.

A bibliography of water resources of Puerto Rico includes 300 titles and a short abstract of each entry. These works are classified in accordance with the nine categories established by the Committee on Water Resources Research of the Federal Council of Science and Technology. Category and author indexes are given. Some articles have been classified in more than one category. First, under that which describes the nature of its principal theme, and second under those that describe its secondary subject. The author index is arranged in alphabetical order, and the works are identified by their abstract number. (Knapp-USGS)
W70-03245

THE MANAGEMENT AND CONTROL OF WATER IN PUERTO RICO,
Puerto Rico Univ., Mayaguez. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 04A.
W70-03246

THE ISSUE OF THE LAKEFRONT, AN HISTORICAL CRITICAL SURVEY,
Douglas Schroeder.
Chicago Heritage Committee Newsletter, No. 5, 1964. 33 p, 31 ref.

Descriptors: *Lake Michigan, *Lake shores, *Recreation, *Planning, *Beaches, Lakes, Shores, Recreation facilities, Land forming, Landscaping, Compensation, Beach erosion, Littoral drift, History.
Identifiers: *Chicago, Illinois.

This study discusses the failure of the Chicago Park District to provide adequate planning for the Lakefront Park System. A historical survey of the development of the Chicago lakefront is used as a vehicle to provide the context for present planning as well as illustrate good planning in the past. A number of objectives for a comprehensive plan of the lakefront are outlined (1) separation of pedestrian and vehicular traffic; (2) subordination of roadways and parking lots to pedestrian usage; (3) elimination of non-conforming commercial usage; (4) provision for location of desirable commercial concessions, i.e., restaurants, boating, etc.; (5) provision for location of new institutions, i.e., museums, art galleries, athletic fields, etc., and their parking and servicing elements; (6) adequate controls to guarantee that if park land is taken for non-park usages such as superhighways, compensatory land near that taken will be given for park land; (7) integrated design of all park elements including signs, street lighting, beaches, etc.; and (8) a capital improvements program for accomplishing plans and allocating resources. This report illustrates some of the difficulties encountered in lakefront planning. (Davis-Chicago)
W70-03338

FLOOD PLAIN MANAGEMENT--WHEREIN LIES THE MYTH,
Office of the Chief of Engineers (Army), Washington, D.C.
George R. Phippen.
Paper presented at the Seventh Biennial Hydraulics Conference, Washington State Univ., Pullman, Wash., 14 Nov 1969. 17 p, 3 fig.

Descriptors: *Flood control, *Flood damage, *Flooding, *Flood plains, Flood protection, Damages.
Identifiers: *Flood plain management.

A flood plain management program should be a comprehensive program, thought of in terms of objectives rather than the means of achieving these objectives. The foundation for understanding flood plain management is the flood hazard; a function of flooding and the susceptibility to damage and disruption. Flooding is described by those physical attributes such as area involved, depths involved, hydro-dynamic and hydro-static aspects, time aspects, and pollution and debris aspects. The susceptibility to damage and disruption represents the degree to which cultural features; structures, crop land, continuity of business, etc.; are affected by flooding. Two additional principles of intelligent flood plain management are the nature of and need for stating objectives requiring resolution of the hazard and fitting the flood plain into a larger scheme; and the kinds of optional means available for achieving objectives. It is concluded that flood control myth, is dispelled when flood control is viewed in this larger context of flood plain management. (Davis-Chicago)
W70-03340

LINCOLN'S EXPERIENCE IN REGULATING FLOOD PLAIN DEVELOPMENT,
Lincoln City-Lancaster County Planning Commission, Nebr.
For primary bibliographic entry see Field 06F.
W70-03341

THE ROLE OF OPEN SPACES IN FLOOD PLAIN MANAGEMENT,
Commissioner of Parks and Public Property, Cedar Rapids, Iowa.
For primary bibliographic entry see Field 06F.
W70-03342

PUBLIC HEALTH, POLLUTION CONTROL, AND PROTECTION OF NATURAL RESOURCES.
For primary bibliographic entry see Field 05G.
W70-03345

A COMPREHENSIVE APPROACH TO THE MANAGEMENT OF PHOSPHATES,
Chicago Univ., Ill. Center for Urban Studies; and Bauer Engineering, Inc., Chicago, Ill.
For primary bibliographic entry see Field 05D.
W70-03346

INHERENT DIFFERENCE BETWEEN WATER AND OTHER NATURAL RESOURCES.
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
Earnest Boyce.
Journal, Water Poll Contr Fed, Vol 41, No 10, p 1697-1701, Oct 1969.

Descriptors: *Water resources development, *Natural resources, *Water development, Water rights, Water law, Planning.

An attempt has been made (a) to point out some of the special problems of water control and development that make this resource inherently different from others and (b) to indicate a few of the legal aspects of these special problems. As a resource, water is a requirement so basic to man's existence that all other resources are either dependent on its plentiful supply or, in its absence, valueless for man's use and development. While many natural resources vanish with use, most water usages produce changes in the position, quality, and/or quantity of the water, depending on how it is used. The multiple usage of the resource, water, within one hydrologic cycle, is frequently an economic necessity. A final distinction is the unpredictable variations in the quantity available from rain and snowfall in any period of time and in any locality. This hydrologic variation is compounded by the variation of human use which is frequently in conflict with the hydrologic variation. This conflict is resolved by some form of water development and management scheme. However, the increase in water use tends to create legal difficulties based on the inadequacies of existing water laws in the case of greater demand than supply. (Davis-Chicago)
W70-03348

SOCIAL BENEFIT VERSUS TECHNOLOGICAL RISK,
California Univ., Los Angeles.
Chauncey Starr.
Sci, Vol 165, No 3899, p 1232-1238, Sept 1969. 7 p, 7 fig, 12 ref, append.

Descriptors: *Risks, Social aspects, *Social values, Project benefits, Public health, Public works, Public benefits, Technology, Accidents, Welfare (Economics), *Hazards, *Safety, Benefit-cost ratios, *Benefits, Acceptability, Comparative benefits, Optimum development plans, Economic justification, Economics, Planning.
Identifiers: Social acceptance, Technical resources, Engineering works.

The evaluation of technologic developments normally relates the expected technical performance to the required investment of resources. Such performance/cost relationships are useful for choosing between alternative solutions, but do not determine how much technology a society can justifiably purchase. A knowledge of the relationship between social benefit and justified social cost is needed to determine the optimum investment of resources. An approach is presented for measuring benefit relative to cost, specifically for accidental deaths arising from technological developments in public use. The analysis is based on 2 assumptions: (1) historical accident records reveal consistent patterns of fatalities in the public use of technology, and (2) historically revealed social preferences and costs are sufficiently enduring to permit use for predictions. Comparisons are made between risks and benefits to evaluate the willingness of society to accept risks. The method provides an approach for answering the question of how safe is safe enough, and may be a means of giving insight on social benefit relative to cost that is so necessary for judicious material decisions on new technological developments. (USBR)
W70-03377

LAND AND WATER CONSERVATION FUND ACT.

Federal Assistance in Outdoor Recreation, Publication No 1, 1968. 99 p.

Descriptors: *Administrative agencies, *Water resources development, *Water conservation, *Water quality control, Federal government, Planning, Recreational facilities, Cost allocation, Land reclamation, Wildlife conservation, Aquatic life, Ecology, Soil conservation, Sedimentation, Erosion, Drainage, Public health, Flood control, Natural resources, Reservoirs, Navigation, Fish management, Meteorology, Grants, Watersheds (Basins).

The Land and Water Conservation Fund Act provides for grants to states and their subdivisions for planning, acquisition, and development of public outdoor recreation areas and facilities. Various federal agencies play a role in the implementation of this program including: the Departments of Interior, Agriculture, Commerce, Defense, Housing and Urban Development, Labor, and Transportation; the Appalachian Regional Commission; the Office of Economic Opportunity; the Tennessee Valley Authority; and the Department of Health, Education, and Welfare. Planning and Research are priorities in the act, both on the state and federal level. Cost sharing and allocation provisions for the various projects are included. Priorities in the implementation of projects include: natural beauty, fish and wildlife conservation, water resources development, water pollution control, soil conservation, land reclamation, public health, water supply, and general ecological considerations. The transfer of land from the federal government to the states for recreational purposes is permitted. Federal agencies are instructed to provide techical assistance to the states in the planning and construction of projects. (Duss-Florida)
W70-03390

LAND AND WATER CONSERVATION FUND ACT (DEPARTMENT OF INTERIOR).
Federal Assistance in Outdoor Recreation, Publication No 1, 1968. 21 p.

Descriptors: *Administrative agencies, *Recreation facilities, *Water resources development, *Water conservation, Planning, State governments, Federal government, Land reclamation, Financing, Public health, Fish management, Wildlife management, Fisheries, Aquatic life, Lakes, Flood control, Water quality control, Water pollution control, Water supply, Waste treatment, Geological surveys, Research, Navigable waters, Ecology, Hydrology.

To qualify for federal grants, states must prepare comprehensive outdoor recreational plans to be approved by the Bureau of Outdoor Recreation. In administering this act, the Bureau is to give special consideration to natural beauty and other qualitative aspects of environment. Among its duties the Bureau is to promote coordination of recreation programs, determine costs and benefits attributable to recreation, and develop policies related to wildlife, waterfowl, natural beauty, and recreational areas. The cost of transfer of federal land to states by purchase or lease is outlined. The Bureau of Sports Fisheries and Wildlife is to assist states and other organizations in realizing the potential of fish and wildlife resources. Funds are allocated and technical assistance is provided for the restoration of fish and wildlife resources. Programs include development of anadramous fish resources, fish hatcheries, and water resource development projects. The Federal Water Pollution Control Administration is to develop plans and programs to assure adequate water supply of the quality necessary for public, industrial, recreational, and conservation needs. The Geological Survey conducts investigations to determine the best use of the nation's water resources. The survey measures the flow and sediment discharge of rivers, reservoir contents, the chemical quality and temperature of waters, and determines the availability of water supplies. Appropriations are made to states for Water Resources research and training. (Duss-Florida)
W70-03391

LAND AND WATER CONSERVATION FUND ACT (DEPARTMENT OF AGRICULTURE).
Federal Assistance in Outdoor Recreation, Publication No 1, p 21-34, 1968. 14 p.

Descriptors: *Administrative agencies, *Recreation facilities, *Water conservation, *Water resources development, Watershed management, Cost sharing, Erosion control, Sedimentation, Streams, Lakes, Reservoirs, Irrigation districts, Drainage districts, Construction, Fishing, Wildlife conservation, Water pollution control, Flood control, Legal aspects, Financing, Water management, Rural areas, Public lands, Farm management, Impoundments, Impounded waters.

The Department of Agriculture and its subdivisions have a major interest in programs for outdoor recreation. The Soil Conservation Service provides technical assistance to landowners and helps states in the development of water-based recreational areas. The Agricultural Research Service conducts research on the production of food and conservation of soil and water resources. Projects include: control of disease, insects, and weeds; soil and water management to minimize erosion and sedimentation of streams and reservoirs; and recreational planning. The Agricultural Stabilization and Conservation Service under the Agricultural Conservation Program (ACP) shares costs with farmers to carry out soil, water, woodland, and wildlife conservation projects. Water impoundment projects help to improve hunting and fishing and water resources. Cropland adjustment and conversion programs are encouraged to divert land to recreational use and conservation needs. Financing of projects by associations and individuals is permitted. Loans are available for watershed projects carried out by state conservation, drainage, irrigation, or flood prevention districts. Cost sharing is also available for providing sanitary facilities and facilities needed for recreation. (Duss-Florida)
W70-03392

LAND AND WATER CONSERVATION ACT (DEPARTMENTS OF COMMERCE AND DEFENSE).
Federal Assistance in Outdoor Recreation, Publication No 1, p 35-46, 1968. 11 p.

Descriptors: *Administrative agencies, *Recreational facilities, *Water resources development, *Water conservation, Tourism, Natural resources, Fish conservation, Wildlife conservation, Reservoirs, Tides, Charts, Weather forecasting, Warning systems, Navigation, Estuaries, Channels, Harbors, Flood control, Streamflow, Flood plains, Regulation, Regulated flow, Boating, Shore protection, Projects, Financing.
Identifiers: Corps of Engineers.

The Business and Defense Services Administration will give information to businessmen concerning equipment and facilities used in outdoor recreation. Economic development programs for substandard areas, controlled by the Department of Commerce, may be devoted to tourism, recreation, and fish and wildlife. The Environmental Science Services Administration (ESSA) produces charts required in marine navigation. The charting program includes investigation of navigational hazards, prediction of tides and tidal currents, and research and development. The ESSA, through the Weather Bureau, is responsible for keeping the public informed of weather conditions influencing recreational activities. It accomplishes this by means of weather forecasts including river forecasts, flood warnings, and flow information. The United States Army Corps of Engineers is in

charge of projects concerning navigation, flood control, hydroelectric power production, shore restoration and protection, water supply, streamflow regulation, fish and wildlife conservation, and recreation. The Secretary of the Army is authorized to grant leases of project lands to nonfederal governmental bodies without charge. Administration of recreational water resources projects shall be on a cost sharing basis. The Corps of Engineers plans and constructs harbors and channels for purposes of navigation and prepares charts of the Great Lakes. The federal government assumes the cost of restoration and protection of federally owned shores. (Duss-Florida)
W70-03393

LAND AND WATER CONSERVATION FUND ACT (THE APPALACHIAN REGIONAL COMMISSION, TENNESSEE VALLEY AUTHORITY, THE WATER RESOURCES COUNCIL, AND CERTAIN DEPARTMENTS).

Federal Assistance in Outdoor Recreation, Publication No 1, p 47-99, 1968. 53 p.

Descriptors: *Administrative agencies, *Recreational facilities, *Water pollution control, *Water resources development, Planning, Abatement, Research, Potable water, Environmental sanitation, Solid wastes, Water supply, Water utilization, Projects, Conservation, Health, Cost sharing, Natural resources, Legal aspects, Navigation, Wildlife management, Reservoirs, Fishing, Public rights, Reclamation, Flood control, Bodies of water.

Under the Department of Health, Education, and Welfare, the National Center for Urban and Industrial Health has instituted programs for environmental sanitation, solid waste disposal, water supply, and sea resources. The Department of Housing and Urban Development is authorized to assist in recreation projects. There is an Open-Space Land Program for these purposes. Recreation projects may include improvement of parks and waterfront areas and construction of rain shelters and sanitary facilities. The Department of Transportation is to strive for a system of highways which serves to promote roadside development and highway access, and which focuses attention on outdoor recreation. Priorities in this include conservation of recreation, natural resources, and fish and wildlife. The United States Coast Guard is responsible for enforcement of federal laws on the high seas and in United States waters. It further functions to aid navigation and water safety. The Appalachian Regional Commission initiates project proposals and plans for the region, many of which are to benefit recreation and fish and wildlife resources. The Tennessee Valley Authority is to encourage the development of recreation resources resulting from its construction of a water control system. The Water Resources Council administers a program of grants to states to assist in the development of water and land related resource plans. (Duss-Florida)
W70-03394

WATER RESOURCES.
Tenn Code Ann secs 70-2001 thru 70-2005 (Supp 1969).

Descriptors: *Tennessee, *Water conservation, *Water resources, *Water resources development, Legislation, Administrative agencies, Administration, Water policy, Water pollution, Water supply, Water rights, Dams, Recreation, Environmental sanitation, Navigation, Resource development, Conservation, Optimum development plans, Water requirements, Competing uses, Engineering personnel, Water pollution control.

A Water Resources Division is created within the Department of Conservation. The Commissioner of Conservation shall appoint a professional water engineer to head this Division. The engineer shall be responsible for all matters relating to the conservation, protection, and development of the water resources of the state, as well as the creation and development of a long range water resource policy. Special matters of water pollution control are reserved for the Stream Pollution Control Board. Specific duties of the engineer include the authority to: (1) establish, maintain and publish an inventory of the state's water resources; (2) establish estimates of existing and future water use in the state; (3) propose necessary water control districts; (4) create and define the rights of respective competing users of water resources; (5) perform assigned duties relating to determining waters that should be reserved for general public purposes; (6) determine the feasibility of proposed dams; and (7) perform other duties required by the Commissioner of Conservation. Any person withdrawing fifty thousand or more gallons of water per day from the water resources of the state must register such withdrawal when required by the Water Resources Division. (Schram-Florida)
W70-03421

TENNESSEE-TOMBIGBEE WATERWAY DEVELOPMENT COMPACT.
Tenn Code Ann secs 70-2101 thru 70-2104 (Supp 1969).

Descriptors: *Tennessee, *Interstate compacts, *River basin development, *Tennessee River, Interstate rivers, Rivers, Streams, River basins, River basin commissions, Basins, Water resources development, Optimum development plans, Transportation, Interstate commissions, Federal government, Legislation, State governments, Administrative agencies, Navigable waters, Navigable rivers, Channels, Channel improvement, Alabama, Mississippi, Navigation.

The Governor is authorized to execute this compact with Alabama and Mississippi. The purpose of this compact is to promote the development of a navigable waterway connecting the Tennessee River, Tombigbee River, Mackeys Creek, and Yellow Creek so as to provide a nine-foot navigable channel between Demopolis, Alabama and Pickwick Pool, Mississippi, and establish an interstate authority to assist in these efforts. The Tennessee-Tombigbee Waterway Development Authority is hereby created. The Authority is empowered to: hold hearings, conduct studies and surveys of all matters concerning development of the Tennessee-Tombigbee Waterway, acquire money and property for use in the program, cooperate with other public or private groups with an interest in the area, execute plans and policies for putting the purpose of this compact before Congress and other federal agencies, and exercise such other powers as may be appropriate to carry out the purposes of this Compact. All officers of this state are directed to do all things within their jurisdiction to aid in carrying out the purposes of this Compact. (Smith-Florida)
W70-03422

ECONOMIC EVALUATION OF WATER QUALITY, FINAL REPORT,
California Univ., Berkeley. Sanitary Engineering Research Lab.
For primary bibliographic entry see Field 05G.
W70-03428

WATER RESERVOIR SYSTEMS.
Autonetics Division of North American Rockwell Corporation, Anaheim, California, Life Sciences Operations.
For primary bibliographic entry see Field 04A.
W70-03435

REVIEW AND ANALYSIS OF THE COSTS OF DESALTED SEA WATER,
Massachusetts Inst. of Tech., Cambridge. Dept. of Economics; and Massachusetts Inst. of Tech., Cambridge. Alfred P. Sloan School of Management.
For primary bibliographic entry see Field 03A.
W70-03453

WATER DEVELOPMENT AUTHORITY.

Ohio Rev Code Ann secs 6121.01 thru 6121.05 (Page Supp 1970).

Descriptors: *Ohio, *Administrative agencies, *Water resources development, *Water pollution control, Beneficial use, Water resources, Water quality, Pollution, Abatement, Public health, Sewage, Industrial wastes, Waste water, Water management, Waste treatment, Costs, Construction, Projects, Surface waters, Groundwater, Water utilization, Solid wastes, Aquatic life, Wildlife, Bodies of water, Flow.
Identifiers: *Water development authority.

Various terms related to water resources and water conservation in Ohio are defined including: beneficial use, waters of the state, water resources, water development project, pollution, industrial waste, waste water, waste and water management facilities. It is the state policy of Ohio to conserve, develop, utilize and maintain its water resources; to prevent or abate water pollution; and to promote the beneficial use of state waters. Pursuant to this policy, the Ohio Water Development Authority is created. The Authority may make loans or grants to governmental agencies for the acquisition or construction of water development projects. It may establish rules and regulations for use of water development projects. It may also establish rules and regulations to protect augmented flow in state waters brought about by development projects, and may provide standards for withdrawal of augmented flow. Methods of financing, operation, and supervision of water development projects are described. The Authority may engage in research and development with respect to waste water and water management facilities. (Duss-Florida)
W70-03575

GREAT LAKES BASIN COMPACT.

Ohio Rev Code Ann secs 6161.01 thru 6161.03 (Page Supp 1970).

Descriptors: *Ohio, *Interstate compacts, *Water resources development, *Water conservation, Great Lakes, Basins, Navigation, Water supply, Recreation, Water utilization, Legislation, Fisheries, Wildlife conservation, Fish conservation, Regulation, Flood plain zoning, Harbors, Water levels, Research, Water pollution control, Soil erosion, Bank erosion, Floods, Interstate commissions, Diversion, United States, Administrative agencies.
Identifiers: *Great Lakes Commission.

The Great Lakes Basin Compact is herein ratified and enacted. The purposes are to: promote the development, use, and conservation of water sources of the Great Lakes Basin; to derive maximum benefit from public works related to navigation and other activities; and to advise in securing a proper balance among the various legitimate uses of water resources. The Compact will be effective when enacted by the legislatures of any four of the states of Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin. Pursuant to this Compact a Great Lakes Commission is created, and its composition and method of operation are described. The Commission has the power to: collect and interpret data on water resources; make recommendations on water resources development and conservation; consider the need for public works related to water resources; consider means of improving navigation and improving and maintaining fisheries; and recommend policies related to water resources. Each state shall consider the Commission's recommendations concerning: stabilization of lake levels; measures for combating pollution, floods and beach erosion, navigation aids and improvements; cooperative fishing laws and fish management; cooperative programs for soil and bank erosion; and diversion of waters. (Duss-Florida)
W70-03577

SOIL AND WATER CONSERVATION COMMISSION.

Ohio Rev Code Ann secs 1515.01 thru 1515.14 (Page 1964), as amended, (Supp 1970), secs 1515.15 thru 1515.29 (Supp 1970).

Descriptors: *Ohio, *Flood control, *Water resources development, *Water conservation, Administration, Soil conservation, Administrative agencies, Legislation, Legal aspects, Natural resources, Regulation, Financing, Planning, Surveys, Investigations, Flood damage, Soil erosion, Taxes, Water utilization, Construction, Cost sharing, Water pollution control, Pollution abatement, Operation and maintenance.

The Soil and Water Conservation Commission is established with the following duties and powers: (1) to assist and encourage cooperation between the soil and water conservation district supervisors; (2) to disseminate information to district supervisors; (3) to seek the cooperation and assistance of federal agencies on behalf of the districts; (4) to recommend legislation which will encourage proper management of natural resources; and (5) to recommend to the Director of the Department of Natural Resources priorities for planning and construction of small watershed projects. Landowners within a given territory may petition the Commission to establish a district within that territory. If the Commission determines there is a need for the district it may order a referendum to be held. Once a district is created, supervisors will be elected in the manner set forth. District supervisors have the following powers: (1) to conduct surveys, investigations, and research relating to soil and water conservation and flood control; (2) to draft and implement plans for conservation of soil and water resource and for flood control; and (3) to cooperate with land occupiers in carrying out the foregoing powers. Financing of district projects is provided for through taxation, special assessments, and bond issues. (Keith-Florida)
W70-03578

ANALYSIS OF MANAGERIAL, FINANCIAL, AND REGULATORY FUNCTIONS OF REGIONAL WATER RESOURCES AUTHORITIES AND OTHER INSTITUTIONAL ARRANGEMENTS.
Booz-Allen and Hamilton, Inc., Washington, D.C.

Available from the Clearinghouse as PB-189 339, $3.00 in paper copy, $0.65 in microfiche. Technical Completion Report, Jan 1970. 99 p, 15 tab, 1 fig, 91 ref, 3 append. OWRR Project C-1370 (1974).

Descriptors: *Administrative agencies, *River basins, *Management, Planning, Federal Government, State government, Local government, Compacts, Water rights.
Identifiers: *Organizational arrangements, Interagency committee, River basin commission, Private corporation, Special districts, Federal regional agency.

An analysis was made of different types of regional water resources institutional arrangements in an attempt to describe the distinguishing characteristics of each and to ascertain their inherent strengths and weaknesses. Seven river basins were selected to provide examples of the implementation of six different regional arrangements. An analysis of each of the seven basins is presented with primary emphasis placed upon the organizational arrangements that have evolved for planning and operating. The selected basins were: (1) the Colorado River Basin, (2) the Columbia River Basin, (3) the Miami River Basin, (4) the Wisconsin River Basin, (5) the Delaware River Basin, (6) the Tennessee River Basin, and (7) the Colorado River Basin (Texas). Major conclusions include: (1) the river basin commission, the intrastate special district, and the federal interstate compact hold the most promise for river basin development, (2) the federal regional agency is an effective arrangement but implementation difficulties prohibit its widespread use, and (3) the major weakness of the basin interagency committee arrangement is its lack of authority to implement the plans created.
W70-03611

THE ROLE OF RESERVOIR OWNER POLICIES IN GUIDING RESERVOIR LAND DEVELOPMENT,
North Carolina Water Resources Research Inst., Raleigh.
Raymond J. Burby, III.
Available from the Clearinghouse as PB-189 408, $3.00 in paper copy, $0.65 in microfiche. Interim Report, North Carolina Water Resources Research Institute, Report No 29, Nov 1969. 56 p. OWRR Project B-012-NC.

Descriptors: *Reservoirs, *Recreation, *Land development, *Lake shores, *Local government, *Planning, *Land use, *Land management, Forest management, Southeast U. S., Inter-agency cooperation, Recreation facilities, Zoning, Urbanization, *Water resources development, Developed waters, Aesthetics.
Identifiers: *Reservoir owners, Land acquisition, Residential use, Commercial use, Industrial use.

Land adjoining reservoirs with recreation potential has been developed at an increasing rate since 1960. A survey of 105 large multipurpose reservoirs in the Southeast indicated that these reservoirs have attracted over 60,000 homes and summer cottages. This rapid development is occurring in a governmental vacuum. Under ten percent of the reservoirs surveyed have land use plans, zoning, or subdivision regulations to guide the development of adjacent non-public land. In the absence of local government initiative reservoir owners may have a key role in maintaining the quality and public usefulness of reservoir shorelands. This report investigates reservoir owner policies which may be used to influence the location and character of shoreland development. Policies considered include land acquisition, residential, commercial, industrial, recreation, and forest land utilization, land management, and inter-agency cooperation. The experience of 25 Southeastern reservoir owners, including Corps of Engineers' districts, private power companies, and TVA, interviewed for this report indicates a wide variation in the current application of each of the above policies, but suggests that reservoir owners, in cooperation with local governmental units, can develop policy mixes adequate to protect reservoir shoreland environments.
W70-03616

AN ECONOMIC APPROACH TO REGIONAL INDUSTRIAL WASTE MANAGEMENT,
Clemson Univ., S.C. Dept. of Environmental Systems Engineering.
For primary bibliographic entry see Field 05G.
W70-03619

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

THE ECONOMIC VALUE OF WATER IN INDUSTRIAL USES,
Rice (Cyrus Wm.) and Co., Pittsburgh, Pa.
Henry C. Bramer, and Donald J. Motz.
Available from the Clearinghouse as PB-189 248, $3.00 in paper copy, $0.65 in microfiche. A continuation of OWRR Contract 14-01-001-1581. (See Vol 2, No 9, Field 6C, entry W69-03322). Completion Report, Dec 1969. 192 p, 16 tab, 2 fig, 3 append. OWRR Project C-1511 (1990).

Descriptors: *Industrial water usage, *Industrial water costs, *Economic efficiency, Statistical model, Data acquisition form, Water resources utilization.
Identifiers: *Water utilization, Data acquisition, Mathematical model.

A study was made to acquire and evaluate data on the cost of industrial water utilization in the steel, paper, chemical, and petroleum industries in sufficient quantity to provide statistically reliable data on each industry as a whole. Data was collected with the industrial water use data form developed for this study. A statistical model was developed to supply a means by which industrial water utilization costs could be formulated by machine computation from the input data forms, used to construct models of industrial water utilization systems, and used to generate formatted data on industrial water utilization costs. The study was used to illustrate how data on industrial water costs can be used to promote more efficient water resource utilization by industry, government, and other water resource planners.
W70-03431

COST HANDBOOK FOR INDUSTRIAL WATER USES,
Rice (Cyrus Wm.) and Co., Pittsburgh, Pa.
Henry C. Bramer, and Donald J. Motz.
Available from the Clearinghouse as PB-189 253, $3.00 in paper copy, $0.65 in microfiche. Completion Report, Dec 1969. 62 p, 16 tab, 2 fig, 1 append. OWRR Project X-105 (1997).

Descriptors: *Water use cost, *Cost per unit product, Steel, Paper, Chemical, Petroleum, Mathematical model, Data retrieval.
Identifiers: *Process water, *Water utilization cost, Heavy industry, Water quality, Waste treatment, Statistical analyses of data.

This handbook illustrates the application of the methods developed in the study entitled 'The Value of Water in Industrial Uses - A Continuation.' It presents general conclusions as to the nature of industrial water utilization and costs, illustrates the utility of the Industrial Water Use Data Form in formatting and retrieving data, illustrates the ability of the form in compiling data, and the use of the data generated in specific problem areas. General conclusions were: (1) The cost of industrial water utilization are best determined on the basis of cost per unit product, (2) Water utilization costs were not found to be definable functions of the age of the plant or level of technology, and (3) In general, industrial water utilization costs have not been shown to be predictably or functionally related to many water use parameters. More specific conclusions and examples are given for the industries. (Hutchins-NUS Corporation)
W70-03432

PROCEEDINGS WORKSHOP ON WATER AND SEWER CHARGES AS RELATED TO WATER USE AND WASTE CONTROL.
North Carolina Water Resources Research Inst., Raleigh; North Carolina State Univ., Raleigh; and North Carolina Univ., Chapel Hill.
For primary bibliographic entry see Field 05G.
W70-03439

DRAINAGE DISTRICTS (TAXATION).
For primary bibliographic entry see Field 04A.
W70-03569

LEVEES.
For primary bibliographic entry see Field 04A.
W70-03581

MATHEMATICAL MODEL OF SEWAGE SLUDGE FLUIDIZED BED INCINERATOR CAPACITIES AND COSTS,
General American Transportation Corp., Niles, Ill.
For primary bibliographic entry see Field 05G.
W70-03610

6D. Water Demand

DETERMINATION OF DOMESTIC WATER CONSUMPTION RATES UNDER VARYING WATER PRESSURES,
Puerto Rico Univ., Mayaguez. School of Engineering.
Luis A. Nunez.
Available from the Clearinghouse as PB-789 158, $3.00 in paper copy, $0.65 in microfiche. Water Resources Research Institute Technical Completion Report, Puerto Rico University, Dec 1969. 72 p, 2 fig, 1 tab, 7 ref, 5 append. OWRR Proj No A-008-PR.

Descriptors: *Water utilization, *Domestic water, *Water pressure, *Puerto Rico, Water supply, Water distribution (Applied), Water management (Applied), Water policy, Water works, Water demand, Planning.
Identifiers: Water pressure-consumption relations, Domestic water consumption.

An experimental study of water consumption in Mayaguez, Puerto Rico determined that pressure is not related to domestic consumption. The cause of variations in the city's domestic consumption was not determined. Data used in the study are tabulated. A brief literature review summarizes the findings of recent studies and consumption surveys. (Knapp-USGS)
W70-03247

PAYMENTS TO STATE FOR WATERS DIVERTED.

NJ Stat Ann secs 58:2-1, 58:2-2, 58:2-4 (1966).

Descriptors: *New Jersey, *Diversion, *Water rates, *State governments, Legislation, Legal aspects, Diversion loss, Returns, Cities, Water supply, Streams, Rates, Administrative agencies.

Every municipality, corporation, or private person diverting the waters of streams or lakes with outlets for the purpose of a public water works shall make payments to the state for all such water diverted in excess of a total amount equal to 100 gallons daily for each inhabitant of the municipalities supplied, as shown by the census of 1905, or in excess of such amount as was legally diverted in 1907. The state Water Policy Commission shall provide maximum and minimum rates for water so diverted. Any water used for manufacturing and fire purposes only and returned without pollution to the stream from which it was taken shall not be included in the aggregate amount diverted. There is a state fee charged for water diverted from subsurface, well, or percolating water supplies acquired by condemnation by exercising the state's right of eminent domain. (Sisserson-Florida)
W70-03517

6E. Water Law and Institutions

FISHING - UNLAWFUL METHODS.
Ind Ann Stat secs 11-1605 thru 11-1614 (1956), as amended, (Supp 1968).

Descriptors: *Indiana, *Fish, *Fishing, *Fishing gear, Legislation, Regulation, Administration, Sport fishing, Explosives, Electrical shocking gear, Fish toxins, Poisons, Nets, Seines, Trout, Minnows, Bass, Crayfish, Fish conservation, Fish management.
Identifiers: Penalties (Criminal).

It is unlawful to use seines, nets, traps, gaff hooks, snares, gigs, spears, electrical devices, explosives, fish toxins, or poisons for fishing. Penalties for violation of these provisions are set forth. Nets are permitted in Lake Michigan and the Wabash River boundary waters. Trot lines and similar devices are unlawful except at certain times and in certain geographical locations. The taking and transporting of minnows is regulated as are the permissible methods for the taking of trout, gar, dog fish, and carp. The sale of bass of specified varieties is prohibited unless such sale is for breeding or stocking purposes. The owners of the breeding and stocking ponds must obtain a permit from the Director of the Indiana Department of Conservation. (Moulder-Florida)
W70-03299

INHERENT DIFFERENCE BETWEEN WATER AND OTHER NATURAL RESOURCES.
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
For primary bibliographic entry see Field 06B.
W70-03348

THE FEDERAL VIEW OF DAMAGES AND BENEFITS,
Department of Justice, Washington, D.C.
Clyde O. Martz.
Appraisal J, Vol 37, No 2, p 200-210, Apr 1969. 11 p, 29 ref.

Descriptors: *Damages, *Benefits, *Land appraisal, *Condemnation, *Property values, Right-of-way, Land tenure, Pricing, Value, Severance, Bibliographies, Land, Eminent domain, Condemnation value, Land ownership, Legal aspects.
Identifiers: *Land acquisition, Severance damages, Department of Justice.

When a Federal agency has difficulties in acquiring land for project use, the Department of Justice is requested to institute condemnation proceedings and conduct all negotiations and trial activities. Few cases ever come to trial; 75-80% are settled by judgment entered as a result of stipulations or failure of the landowner to appear. Federal law, not local state law, applies in Federal condemnation cases. One of the most misunderstood and unjustly criticized aspects of eminent domain is the allowance of benefits or value increase of remaining land to offset any compensation award for the land taken or for severance damage. Any enhancement in the value of property taken for a project cannot be considered in determining just compensation. Since benefits must be considered, the remainder is valued to the extent that the value is enhanced by the project. If the land taken is not considered enhanced by the project but the value of the aggregate is considered to be lessened by the taking, the landowner can be made whole by adding his compensation to the sum he might gain from the sale of the remainder in the market. Definitions and discussions are given regarding general, special, direct, and indirect benefits. (USBR)
W70-03361

ENVIRONMENTAL LAW CONFERENCE PROPOSES NATIONAL LEGAL ACTION--INFORMATION CENTER.
For primary bibliographic entry see Field 05G.
W70-03379

PUBLIC RIGHTS TO USE AND HAVE ACCESS TO NAVIGABLE WATERS,
G. Graham Waite.
Wis L Rev, Vol 1958, No 3, p 335-375, May 1958. 41 p, 162 ref.

Descriptors: *Wisconsin, *Riparian rights, *Navigable waters, *Access routes, Legislation, State governments, Competing uses, Remedies, Ownership of beds, Obstruction to flow, Construction, Reasonable use, Recreation, Riparian land, Legal aspects, Boundaries (Property), Boundary disputes, Easements, Judicial decisions, Boating, Sport fishing, Swimming, Aesthetics, Economic impact, Hunting, Lakes.

Wisconsin is involved in determining through legislation, judicial decisions, and administrative regulation whether public or riparian owners shall have access to navigable waters. In analyzing the Wisconsin position, it is concluded that the public's right of access to navigable waters is restricted to those parts of the shoreline that can be reached without crossing private property. In reaching this result, possible alternatives and the policy reasoning behind the conclusion are examined. Priorities between recreational and commercial uses and between riparian and public rights are explored in gaining insight into the state's position. The theories of lake bed and stream bed ownership are considered as justifications of this position, as is the effect of the public right to navigation on navigable streams. The article concludes that for the public to best achieve access to navigable waters it must rely on legislation by local governments to open public roads to such waters. (Barnett-Florida)
W70-03380

MARITIME CONTIGUOUS ZONES,
Lloyd C. Fell.
Mich L Rev, Vol 62, No 5, p 848-864, Mar 1964. 17 p, 84 ref.

Descriptors: *Law of the sea, *International law, *Seas, *Oceans, Admiralty, Navigation, Legislation, Regulation, Littoral, United Nations, Fishing, Coasts, Jurisdiction.
Identifiers: Contiguous zones, Territorial waters.

This is a discussion of the problems involved when a coastal state asserts authority for special purposes over a zone of the sea outside its territorial waters. Early contiguous zones were acquiesced in when they appeared reasonable. The term contiguous zone is generally applied to those areas in which the littoral state exercises limited competence for special purposes, as distinguished from territorial waters over which it has sovereignty. There is no necessary relation between the width of the territorial sea and the establishment of the contiguous zone. A majority of states asserting contiguous zones have laws directed solely at enforcing the rights claimed therein. The problems of territorial seas and contiguous zones are being considered by the United Nations. The Geneva Conferences validated customs, fiscal, immigration, and sanitary zones up to twelve miles from shore which in effect limited the subjects amenable to contiguous zone treatment. (Moulder-Florida)
W70-03381

ARE WE LOSING OUR LAKES,
Roger A. Peterson.
S D L Rev, Vol 3, p 109-125, Spring 1958. 35 p, 89 ref.

Descriptors: *Reservation doctrine, *Ownership of beds, *Riparian rights, *Public rights, State governments, Accretion (Legal aspects), Lake beds, Lakes, Navigable waters, Riparian land, Federal government, Patents, Leases, Non-navigable waters, Minnesota, Illinois, Iowa, South Dakota, North Dakota, State jurisdiction, Federal jurisdiction, Legislation, Judicial decisions.

The article explores a limited cross-section of the divergent judicial decisions dealing with lake bed ownership disputes between the state and littoral owners and the retention of bed ownership by the state for public use. Two theories by which the state may acquire title to submerged beds are explored. The first theory gives the state title to all lakes and rivers which were navigable, according to the federal test of navigability, at the time the state was admitted to the Union. The second theory provides that a state may acquire title to lake beds if the federal government sold the property on which lakes were situated without indicating an intent to reserve or dispose of such property, regardless of the navigability of the lakes. After exploring the background of the federal navigability test, the judicial decisions of Minnesota, Iowa, Illinois, North Dakota, and South Dakota are examined with regard to their method of applying the two theories. It is concluded that Iowa, Illinois, and South Dakota adhere to the second theory, retaining greater ownership for public use. Unrestricted federal

patents vis-a-vis state jurisdiction are discussed. (Barnett-Florida)
W70-03382

ARE WE LOSING OUR LAKES (STATE'S ACQUISITION OF TITLE UPON ADMISSION TO THE UNION),
Roger A. Peterson.
S D L Rev Vol 3, p 109-113, Spring 1958. 5 p, 22 ref.

Descriptors: *Ownership of beds, *Lake beds, *Reservation doctrine, State governments, Public rights, Navigable waters, Federal government, Non-navigable waters, State jurisdiction, Federal jurisdiction, Boundaries (Property), Patents, Judicial decisions, Beds under water, Beds.

Following the American Revolution, each state held title to the beds of all navigable waters. Navigability was determined by the English test of whether the water was affected by the ebb and flow of the tide. Non-navigable beds were owned by the littoral or riparian owners. Each state subsequently admitted to the Union acquired title to navigable waters within its borders. Prior to admission, such waters were held by the federal government in trust for the new states. The English test of navigability was later discarded. For a state to claim title to waterways the test of navigability applied was whether the waters were, in fact, highways of commerce. The federal test differed from later developed state tests; the differences were resolved, however, in United States v Holt State Bank, 270 U S 49 (1926). Simply stated, the law is that each state, upon admission to the Union, acquired title to rivers and lakes if they were at that time navigable under the federal test. Other waters not navigable remain the property of the federal government. (Barnett-Florida)
W70-03383

ARE WE LOSING OUR LAKES. (STATE'S ACQUISITION OF TITLE THROUGH CONSTRUCTION OF FEDERAL PATENTS ACCORDING TO LOCAL LAW),
Roger A. Peterson.
S D L Rev Vol 3, p 113-118, Spring 1958. 6 p, 20 ref.

Descriptors: *Ownership of beds, *Reservation doctrine, *Riparian rights, Accretion (Legal aspects), Federal government, Patents, Non-navigable waters, Federal jurisdiction, Legislation, State jurisdiction, Public rights, Judicial decisions, Beds, Beds under water, Legal aspects.

Judicial decisions are used to show the precedent for applying local law rather than federal law in construing an unrestricted federal patent on non-navigable waters. It is made clear that if, under local law, title to a lake bed is not transferred under a private grant of the upland property, it is not transferred under an unrestricted federal patent. The question of who takes title to a lake bed that is surrounded by littoral owners who are claiming under unrestricted federal patents raises serious questions. An exploration of case law shows an expansion of sources from which restriction may be placed on any patent to avoid such conflicts. It has been concluded, however, that the definition of an unrestricted federal patent is purely a question of fact, dependent upon the intent of the federal government. Federal legislation requiring federal assent to the application of local law in construing its grants is a suggested reform. (Barnett-Florida)
W70-03384

ARE WE LOSING OUR LAKES. (HAVE THE STATES APPLIED BOTH THEORIES TO RETAIN CONTROL OF THE LAKES),
Roger A. Peterson.
S D L Rev, Vol 3, p 118-125, Spring 1958. 7 p, 30 ref.

Descriptors: *South Dakota, *Iowa, *Illinois, *North Dakota, Minnesota, Ownership of beds, Judicial decisions, Accretion (Legal aspects), State governments, Riparian rights, Lake beds, Lakes, Navigable waters, Riparian land, Federal government, Non-navigable waters, State jurisdiction, Public rights.

Two theories of lake bed ownership by the states have been applied. The first theory gives each state title to all navigable waters which were navigable under the federal test at the time of its admission to the Union. Under the second theory, the state may acquire title to lake beds, if the federal government transferred lake-front property without reservations, whether the lake is navigable or not. Minnesota applied a local test until 1957, when their state supreme court stated the rule that Minnesota could assert ownership over waters, as an incident of statehood, due to their navigability as determined by the federal navigability test. North Dakota followed the Minnesota test. In South Dakota, the Minnesota test was adopted, but pursuant to statute the state was deemed to own all waters which were navigable under the federal test. Iowa has avoided using the two theories explicitly, but implicit in its court decisions is the policy that the littoral owner does not acquire title to lake beds and that the state has sufficient interest to protect non-navigable lakes. Illinois has adopted the first theory by merely making a meander line conclusive evidence of navigability and thus vesting all ownership of navigable lake beds in the state. (Barnett-Florida)
W70-03385

OWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA,
Roger H. Doyle.
1963 Tulane Tidelands Inst, p 28-46, Claitor's Book Store, Baton Rouge, La. 18 p, 65 ref.

Descriptors: *Louisiana, *Beds, *Rivers, *Ownership of beds, Beds under water, Dry beds, Lake beds, River beds, Streambeds, Channel erosion, Navigable rivers, Banks, Bank erosion, Stream erosion, Mineral industry, State governments, Legislation, Shores, Estuaries.
Identifiers: Alienability of waterbottoms.

Inalienability is a characteristic of sovereign ownership of navigable waterbottoms. So long as the common or public uses are preserved, the beds and bottoms of navigable waters are susceptible of private ownership. The actual beds of navigable waters under Roman, Spanish, and common law were alienable when separable from the public use. Louisiana's constitutional prohibition against alienation of the beds of navigable waterways acknowledges their pre-existing susceptibility of private ownership. Adoption of the common law rule would have been more appropriate in a capitalistic society. Act 62 of 1912 cures defects in unauthorized transfers of waterbottoms. Subsequent cases conflict as the whether the beds of navigable waterways are susceptible to private ownership. California Co v Price, 225 La 706, 74 So 2d 1 (1954) cured the title to 4,000 acres of navigable waterbottom. The court in Miami Corp v State, 186 La 784, 173 So (1936) gave the state title to inundated lands on the basis of the insusceptibility of navigable waterbottoms to private ownership. State v Cenac, 341 La 1055, 132 So 2d 928 (1961) held that Price established the validity of private ownership and cast doubt on the validity of the Miami decision. (Dye-Florida)
W70-03386

OWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA (SOVEREIGN OWNERSHIP AND INALIENABILITY I),
Roger H. Doyle.
1963 Tulane Tidelands Inst, p 28-34, Claitor's Book Store, Baton Rouge , La. 7 p, 25 ref.

Descriptors: *Louisiana, *Beds, *Ownership of beds, *Legislation, Rivers, Beds under water, Dry beds, Lake beds, River beds, Streambeds, Navigable rivers, State governments, Riparian rights, Civil law, Legal aspects, Recreation, Relative rights, Public rights, Boundaries.
Identifiers: Alienability of waterbottoms.

Sovereign ownership of waterbottoms is divided into perfect proprietary ownership, dominum, and imperfect ownership, mere regulatory control, imperium. Roman, Spanish and the common law allowed alienation of the dominium, but not the imperium. If the two forms of ownership were inseparable, neither was alienable nor subject to private ownership. Imperium was exerted over the right of public use, as navigation or fishing, while dominium applied to separable physical bed. French law differed from the common law by making inalienable the thing to which the public use related in addition to the use itself. Louisiana Code articles classifying common things derives from Roman law. The article defining things public derives from French law. Thus, historical derivation is of no help in determining a Louisiana rule regarding private ownership of waterbottoms. Early Louisiana cases pronounced waterbottoms insusceptible of ownership subsequent to the first of the 'oyster acts' in 1886. These acts and the prohibition in the 1921 Louisiana Constitution against alienation to private ownership are implicit recognition of a prior susceptibility to such ownership. Adoption of the common law rule would have been more appropriate for a capitalist society. (Dye-Florida)
W70-03387

OWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA (SOVEREIGN OWNERSHIP AND INALIENABILITY II),
Roger H. Doyle.
1963 Tidelands Inst, p 34-38, Claitor's Book Store, Baton Rouge, La. 5 p, 19 ref.

Descriptors: *Louisiana, *Beds, *Ownership of beds, *Legislation, Rivers, Beds under water, Dry beds, Lake beds, River beds, Streambeds, Navigable rivers, State governments, Riparian rights, Legal aspects, Relative rights, Public rights.

In 1908, the Louisiana Supreme Court held that the 1886 'oyster statute' constituted legislative ratification of pre-existing private title to an arm of the sea. The unauthorized alienation of the bottom was found to have been cured by laches on the part of the state. This estoppel by laches was codified by Act 62 of 1912, curing unauthorized or void transfers from the state or its agencies. Courts have not required transfers to be express to benefit from Act 62. Titles to waterbottoms included in a transferred area are also cured. Humble Oil v State Mineral Bd, 223 La 47, 64 So 2d 839 (1953) applied the Act to effect the transfer of the bottom of a navigable waterway by a state agency totally without title. California Co v Price applied the Act to an arm of the sea. Miami Corp. v State, however, gave the state title to inundated land because waterbottoms are insusceptible of private ownership under the codal articles. (Dye-Florida)
W70-03388

OWNERSHIP OF THE BEDS AND BOTTOMS OF NAVIGABLE WATERS IN LOUISIANA (CHANGING SHORELINES),
Roger H. Doyle.
1963 Tulane Tidelands Inst, p 38-46, Claitor's Book Store, Baton Rouge, La. 9 p, 20 ref.

Descriptors: *Louisiana, *Beds, *Ownership of beds, *Lake beds, Lakes, Rivers, Beds under water, Dry beds, River beds, Streambeds, Channel erosion, Banks, Bank erosion, Stream erosion, State governments, Legislation, Shores, Legal aspects, Boundaries (Property), Accretion (Legal aspects), Alluvion, Reliction, Riparian rights.

Miami Corp v State involved title to the bed of a changing body of water. Early cases held that neither accretion of the shores of a lake, nor lands left dry by receding waters accrue to the riparian owner. Conversely, in Miami, the court held that the state acquired title to areas inundated subsequent to the issuance of a patent because the bed was not susceptible to private ownership. On this point, the later California Co v Price case held otherwise. Statutes limit application of the Miami doctrine to true quiescent lakes. Factual distinctions between Miami and Price raise doubts that Miami was overruled. Price did not involve erosion or inundation and applied only to post-patent inundation. State v Cenac involved inundation of patented and unpatented beds, and thus involved the facts of both Price and Miami, and thereby offered an opportunity to reconcile the two doctrines. The state waived this opportunity by insisting that Price be overruled and that post-patent as well as pre-patent inundations cause reversion of beds to the state. The court upheld the Price doctrine and applied it to the entire inundated property, casting the Miami doctrine into even greater doubt. (Dye-Florida)
W70-03389

CONSERVATION OF NATURAL RESOURCES (FISHING).
Ohio Rev Code Ann secs 1533.32 thru 1533.66 (Page 1964), as amended, (Supp 1970).

Descriptors: *Fishing, *Nets, *Ohio, *Recreation, Water utilization, Commercial fishing, Bait fishing, Sport fishing, Electrical shocking gear, Fish hatcheries, Fish management, Baits, Fyke nets, Gill nets, Fishing gear, Marking techniques, Legislation, Local governments, Electro-fishing, Permits, Fish passages, Fish, Public health.
Identifiers: Trap nets, Crib nets.

The Attorney General, the Chief of the Division of Wildlife, and the Director of Natural Resources may enter reciprocal agreements with the proper authorities of other states to regulate the catching of fish. Except for certain circumstances listed, the use of a boat, net, or device for fishing requires a license. Fish shall be taken only by angling, unless otherwise provided by the Revised Code. Requirements for the issuance of permits for private fish hatchery ponds and minnow sales are prescribed. The fishing season for Lake Erie and other waters is established. Commercial fishermen are required to record their daily catch. Fishing devices used in the Lake Erie fishing district are regulated. Specific provisions cover the depth, width, length, and mesh size of several types of nets which may be used in fishing. Unauthorized netting locations, Lake Erie netting season dates, and net inspection methods are described. The use of quicklime, electricity, or any other deleterious substances in Ohio waters is proscribed. Any obstruction to the natural transit of fish is prohibited. Requirements as to length, weight, and methods of taking specific species of fish are designated. Fish lawfully confined by a net or device are property of the owner or person operating such net or device. Each fish illegally taken constitutes a separate offense. (Powell-Florida)
W70-03407

WATERCRAFT; NAVIGATION.

Ohio Rev Code Ann secs 1547.01 thru 1547.78 (Page 1964), as amended, (Supp 1970).

Descriptors: *Ohio, *Waste disposal, *Boating regulations, *Navigation, Boats, Ships, Water skiing, Harbors, Water policy, Water resources development, Recreation, Water law, Water conservation, Legislation, Environmental sanitation, Recreation wastes, Domestic wastes, Construction, Maintenance, Projects, Bank erosion, Shores, Administrative agencies.
Identifiers: *Refuge harbors

Waters of the state and navigable waters are defined. Specifications for watercraft lights and operating regulations for preventing collisions between watercraft are enumerated. Various other regulations pertaining to the operation of watercraft are provided. Water skiing activities and watercraft safety measures are prescribed. Except on designated waters, no person shall operate or use any watercraft containing a sink, toilet, or sanitary system capable of discharging wastes. The Division of Watercraft is created to administer the identification and numbering of watercraft operated on Ohio waters. The Division of Watercraft acts as the refuge and small boat harbor agency for the purpose of working with the Corps of Engineers. The Watercraft Division may construct and maintain refuge harbors and other projects related to light draft vessels and marine recreational facilities. A Waterways Safety Council advises the Watercraft Division Chief as to construction and maintenance of refuge harbor projects and methods of coordinating shore erosion projects with refuge harbor projects. Penalties for violations of various sections of the watercraft laws are enumerated. (Powell-Florida)
W70-03408

BRIDGE COMPANIES.

Ohio Rev Code Ann secs 1741.01-1741.14 (Page 1964).

Descriptors: *Ohio, *Bridge construction, *Bridges, *Ohio River, Railroads, Abutments, Regulation, Permits, State governments, Legislation, Rates, Interstate rivers, Construction, Legal aspects, Financing, Standards, Interstate.
Identifiers: *Tolls, *Bridge companies, Toll rates.

A bridge company must lawfully possess a right in the banks of those streams it intends to build its bridges over. Toll rates for intrastate bridges are stipulated. A bridge built across the Ohio River must conform to congressional standards. The maximum and minimum height of bridges built across the Ohio River is stipulated. Reasonable toll rates may be set by the bridge company, but may never exceed those collected at the Covington-Cincinnati Bridge. Upon payment of a stipulated rate of toll, railroad companies may use such bridges built across the Ohio River. Two bridge companies, from different states, may form one consolidated domestic corporation, subject to the regulations of this state, to build a bridge across the Ohio River. The bridge companies may operate ferries as well as make and enforce all rules necessary to protect their property. (Barnett-Florida)
W70-03409

STATE'S POWER OVER WATERS OF LAKE ERIE AND OVER LEASING OF LAKEFRONT LAND FOR PRIVATE IMPROVEMENT.

Ohio Rev Code Ann secs 123.03, 123.031 (Page 1969), as amended, (Supp 1970).

Descriptors: *Ohio, *Lake Erie, *Riparian land, *Leases, Water rights, Navigation, Land tenure, Shores, Soil management, Littoral, Riparian rights, Channels, Reasonable use, Piers, Landfills, Legislation, Public rights, Administrative agencies, Administrative decisions, Aquatic soils, Local governments, Port authorities, Planning, Programs, Mineralogy, Fisheries.

The water and underlying bed of Lake Erie within the jurisdiction of the state are owned and held by the state for public use, subject to the powers of the United States, rights of public navigation, commerce, and fishery and property rights of littoral owners. The Department of Public Works is responsible for care, protection, and enforcement of the state's interests in this territory. Any owner of uplands fronting on Lake Erie may apply to the state for a lease of the waters and underlying beds or artificially filled lands between the natural shore line and the harbor line, for specified purposes. The Director of Public Works shall determine whether the suggested improvements and developments will impair public rights. The appropriate municipal corporation, county commission, or port authority shall determine whether the territory is needed by that local authority, and whether the proposed use complies with the authority's waterfront plans. The Director shall establish the consideration for and period of such lease. The Governor shall issue the lease certificate, specifically reserving to the state all mineral rights in the leased territory. (Dearing-Florida)
W70-03410

COMPACT CONCERNING PYMATUNING LAKE.
Ohio Rev Code Ann sec 1541.31 (Page 1964).

Descriptors: *Ohio, *Interstate compacts, *Recreation, *Multiple-purpose reservoirs, Multiple-purpose projects, Legislation, Legal aspects, Boats, Safety, Water conservation, Flood control, Pennsylvania, Dams, Swamps, Water pollution, Reservoirs, Jurisdiction, Fishing, Boating.
Identifiers: *Pymatuning Lake.

Ohio hereby enters into a compact with Pennsylvania concerning Pymatuning Lake. Ohio's Conservation Commissioner is authorized to carry out Ohio's duties under the compact. Pennsylvania's agent for purposes of the compact will be its Water and Power Resources Board. The primary purposes of the project, by which the Lake is created, are water conservation, flood control, and regulation of flow in the Shenango and Beaver rivers. The secondary purposes are to permit fishing, hunting, and recreation in such ways as will not interfere with the primary purposes. The Lake will be open to citizens of both states for fishing, hunting, boating, and recreational purposes. Both states will protect the Lake against pollution from all sources. The only restriction on boating is that no motor will be used in excess of ten horsepower. Pennsylvania reserves the unrestricted right to regulate the level of the Lake in furtherance of a primary purpose of the project: regulation of flow in the Schnango and Beaver rivers. (Keith-Florida)
W70-03411

BOOM COMPANIES.

Tenn Code Ann secs 68-201 thru 68-204 (1956).

Descriptors: *Tennessee, *Lumbering, *Streams, *Navigation, Rivers, Inland waterways, River basins, Lumber, Boats, Regulation, Economics, Legislation, Damages, Riparian rights, Legal aspects, Aquatic drift.
Identifiers: Booms, Boom companies, Obstruction to navigation.

Boom companies may float wood, lumber, and logs down any stream or its tributaries, and may construct booms for the purpose of catching and securing their logs, wood, and lumber. Such booms shall not prevent the safe and convenient passage of rafts, logs, and boats on any river. A boom corporation may enter upon the lands of others for the purpose of reclaiming and securing its logs, lumber and rafts. The corporation shall pay any damages caused by the entry, and the logs, lumber or rafts shall be removed within a reasonable time. All logs, lumber or rafts belonging to other parties which may float onto a boom shall be returned to the owners upon proof of ownership. (Smith-Florida)
W70-03412

LANDING AND LOADING FACILITIES.

Tenn Code Ann secs 70-201 thru 70-209 (1956).

Descriptors: *Tennessee, *Transportation, *Navigable waters, *Administrative agencies, Boats, Navigable rivers, Rivers, Streams, Navigation, Communication, Highways, Administration, Inland waterways, River basin development,

Docks, Regulation, Economics, Public benefits, Legislation, Building codes, Access routes.
Identifiers: Landing, Loading, Commerce.

The Commissioner of the Department of Highways and Public Works is authorized to acquire, maintain, and operate any public facilities he may deem suitable for loading and landing cargo wherever state highways intersect or parallel any navigable waters in the state. The Commissioner may perform any acts and make any regulations to carry out the purpose of this act, and is authorized to cooperate with subdivisions and agencies of the state or federal government. The purpose of this chapter is to promote traffic and commerce upon the waters of the state and to aid the United States in improving navigation. Due regard shall be had for the paramount rights of the United States in navigable waters. No owner or operator of any river wharf shall collect any charge for wharfage or landing of boats unless the wharf is in good repair. Failure to keep a wharf in good repair is a misdemeanor. (Smith-Florida)
W70-03414

APPEALS IN DRAINAGE AND LEVEE DISTRICT PROCEEDINGS.

Tenn Code Ann secs 70-1101 thru 70-1109 (1956).

Descriptors: *Tennessee, *Drainage districts, *Judicial decisions, *Adjudication procedure, Legal aspects, Legislation, Levees, Condemnation, Damages, Costs, Jurisdiction, Flood control, Structures, Water law.
Identifiers: Appeal procedure.

Any party aggrieved by a decision of the county court in establishing or refusing to establish a drainage or levee district may appeal to the circuit court. An appeal from a judgment of the county court will not prevent further improvement, appropriation, and condemnation if the district posts a security bond payable to the appellant for double the amount of damages claimed. The circuit court shall hear any such appeal de novo. Any new finding of damages in the circuit court shall be entered in the records of the county court. (Schram-Florida)
W70-03417

WATERS, DRAINS AND LEVEES (BOND ISSUES AND WARRANTS).

Tenn Code Ann secs 70-1401 thru 70-1432 (1956).

Descriptors: *Tennessee, *Government finance, *Administrative agencies, *Drainage districts, Local governments, Loans, Interest, Assessments, Taxes, Legal aspects, Legislation, Land tenure, Judicial decisions, Economics, Administration, Maintenance, Maintenance costs, Jurisdiction, Levees, Land reclamation.
Identifiers: *Bonds.

County courts may authorize the issuance of drainage bonds to fund the reclamation or improvement of drainage areas. The terms of the bonds are to be fixed by the board of directors of the improvement district. The bonds are to be paid by assessments on lands within the district. Bonds for multi-county districts must be approved by each county. Individuals may pay their assessments by tendering bonds to the board of directors. Maintenance and/or administration certificates issued on the bonds or receipts held in that fund will constitute a lein on the land in the district until the assessment is paid. Refunding bonds may also be issued to refund existing bonded indebtedness. Taxes resulting from bonding assessments shall be collected and enforced in the same manner as drainage taxes. The directors of a bonding district may also borrow money to make up deficiencies in collections needed to pay off bonds and interest. Upon default on any bond, a receiver may be appointed to collect the assessments due to the defaulting district. (Dearing-Florida)
W70-03418

BOATING SAFETY ACT OF 1965.

Tenn Code Ann secs 70-2201 thru 70-2225 (Supp 1969).

Descriptors: *Tennessee, *Boating regulations, *Administrative agencies, *Safety, Recreation, Boats, Accidents, Public health, Equipment, Operation and maintenance, Coordination, State governments, Government finance, Education, Administration, Local governments, Coast guard regulations, Skiing, Buoys, Navigation, Inspection, Jurisdiction, Legal aspects, Judicial decisions, Water sports.
Identifiers: Boat registration.

The Tennessee Game and Fish Commission shall enforce this act, the purpose of which is to promote the safety of persons and property in and connected with vessels. The Commission shall establish programs for: (1) public education in boating safety; (2) registration and regulation of vessels; (3) cooperation with other state and federal agencies; and (4) improvement and promotion of the waters for recreational purposes. Vessels other than those specifically exempted must be numbered for identification by the Commission. A Boating Safety Advisory Board is created to advise the Commission on rules and regulations for boating safety. The Commission shall establish rules and regulations governing safety equipment and operation of vessels. The Commission may authorize special aquatic events. Damaging vessels, interfering with navigation aids, and the use of sirens are prohibited. The Commission may license and inspect vessels carrying passengers for hire. Owners are liable for the damage caused by their vessels. (Dearing-Florida)
W70-03423

DRIFTING AND FLOATING TIMBER.

Tenn Code Ann secs 68-102, 68-103 (1956).

Descriptors: *Tennessee, *Lumber, *Aquatic drift, *Compensation, Driftwood, Streams, Rivers, Navigable waters, Boats, Damages, Legislation, Legal aspects.

Timber, whether branded or not, found adrift or floating in any stream or water of this state and which has been prepared for sale without a boom or other arrangement by the owner for the preservation thereof entitles the finder to receive compensation from the owner for as much as he delivers to the owner. The amounts of such compensation are set forth. Any person who takes up and cares for any fleet, raft, or platform of timber shall be entitled to additional compensation. (Smith-Florida)
W70-03426

TELEGRAPH AND TELEPHONES.
Tenn Code Ann secs 65-2101, 65-2105, 65-2106 (1956).

Descriptors: *Tennessee, *Communication, *Navigation, *Transmission, Legislation, Transmission lines, Rivers, Surface waters, Construction, Maintenance, Operation and maintenance, Navigable waters.

Telegraph and telephone corporations can construct telegraph or telephone lines and erect necessary fixtures across, over, or under Tennessee rivers provided the navigation of said waters is not impeded. Any person or corporation organized for the purpose of transmitting intelligence may construct, operate and maintain necessary telegraph, telephone or other lines across and under Tennessee waters. (Powell-Florida)
W70-03427

DUVAL ENGINEERING AND CONTRACTING CO V SALES (RIPARIAN RIGHTS).
77 So2d 431-434 (Fla 1954).

Descriptors: *Florida, *Riparian rights, *Eminent domain, Judicial decisions, State jurisdiction, Ownership of beds, Prescriptive rights, Remedies, Riparian land, Banks, Condemnation, Right-of-way, Beds.

Upland owners sued to enjoin agents of the state from constructing a bridge across a navigable river. Plaintiffs alleged that such construction was either an appropriation of riparian rights or a taking of property which necessitated proceedings in eminent domain. Plaintiffs won on the alternative eminent domain pleading. The state appealed. The supreme court stated that since plaintiff failed to fill in or permanently improve the submerged land continuously from the high water mark in the direction of the channel, the land was therefore subject to reversion and subsequent sale under a statute vesting title in State Road Department. Duval Engineering was therefore lawfully exercising governmental power and respondent was without right to compensation for impairment of riparian rights. (Moulder-Florida)
W70-03563

DRAINAGE DISTRICTS.
For primary bibliographic entry see Field 04A.
W70-03566

WHARVES, DOCKS AND FERRIES.
Pa Stat Ann tit 53, secs 14191, 14193, 14197 (1957).

Descriptors: *Pennsylvania, *Docks, *Piers, *Coastal structures, Bulkheads, Low water mark, High water mark, Legislation, Riparian rights, Easements, Construction, Navigable waters, Administrative agencies, Administrative decisions, Local governments, Marshes, Coastal marshes, Land reclamation, Boats, Navigation, Storage, Basins.

The Director of the Department of Wharves, Docks, and Ferries shall have the power to regulate, fix and establish bulkhead and pierhead lines, and the distance between piers. He may also adopt regulations for the construction, extension, improvement, and repair of wharves, piers, bulkheads, docks, slips and basins. The Director shall have charge of all the wharf storage property belonging to cities of the first class, including all easements, uses, reversions, and rights belonging thereto. The Director shall have authority to purchase, in the name of these cities, such unimproved marshlands as may be reclaimable between the low-water line and the high-water shore-line of the navigable waters. After appropriation of money by the city, the Director may reclaim, fill-in and improve the marsh-lands and construct thereon wharves, piers, docks, slips, basins, and storage facilities. Any land that cannot be improved may be leased or sold. The Director may purchase any coastal structures that are necessary for the purposes of commerce and navigation. He may also purchase, maintain, and operate any boats, launches, ice boats and dredges necessary for the performance of the duties of the Department of Wharves, Docks and Ferries. (Schram-Florida)
W70-03570

TURNPIKE BRIDGE ACROSS THE DELAWARE RIVER.
Pa Stat Ann tit 36, sec 658.2 (1961).

Descriptors: *Pennsylvania, *Bridges, *Highways, Interstate rivers, Interstate compacts, Water resources development, State governments, Water policy, Road construction, Transportation, Bridge construction, Administrative agencies, Administration, New Jersey, Delaware River.

In order to facilitate traffic across the Commonwealth, the Pennsylvania Turnpike Commission is

empowered to construct a turnpike from the eastern extension of the turnpike system to a point on or near the Delaware River between Pennsylvania and New Jersey. At that point, the Commission is to construct, operate and maintain a bridge, either alone or in conjunction with the New Jersey Turnpike Authority. The Commission may acquire the use, operation or maintenance of any bridge across the Delaware River heretofore or hereafter constructed, together with connecting roads, tunnels and bridges. (Smith-Florida)
W70-03571

DELAWARE RIVER PORT AUTHORITY (JOINT COMPACT WITH NEW JERSEY).
Pa Stat Ann tit 36, secs 3503, 3504 (1961), as amended, (Supp 1969).

Descriptors: *Pennsylvania, *Port authorities, *Delaware River, *Interstate compacts, Interstate commissions, Interstate rivers, River basin commissions, Water resources development, State governments, Rivers, Bridges, Bridge construction, Communication, Navigation, Transportation, Eminent domain, Condemnation, Regulation, Cities, Highways, River basin development, Legislation.

Whereas New Jersey and Pennsylvania have a common interest in the development of the Delaware River from Philadelphia and Camden to the sea, and in the operation and regulation of bridges and other forms of communication and trade routes, the Delaware River Joint Commission is continued as the Delaware River Port Authority to effectuate its enumerated purposes. The composition of the Commission is described and its general powers are listed. A limited power of eminent domain is granted, and financial powers and liabilities are described. Various limitations are imposed on the Commission's powers. Rules and regulations are provided for, and policemen for the enforcement thereof may be appointed. (Smith-Florida)
W70-03572

DELAWARE RIVER PORT AUTHORITY (PURPOSES).
Pa Stat Ann tit 36, sec 3503 (1961), as amended, (Supp 1969).

Descriptors: *Pennsylvania, *Interstate commissions, *Delaware River, *Interstate compacts, Interstate rivers, River basin commissions, Water resources development, Rivers, Bridges, Bridge construction, Transportation, Communication, Tunnels, Tunnel construction, Harbors, Eminent domain, Condemnation, Regulation, Cities, Highways, River basin development, Port authorities.

The Delaware River Port Authority is (1) to operate, maintain and improve the bridge between Camden and Philadelphia; (2) to establish and operate facilities for passenger transportation across bridges or tunnels controlled by the Commission; (3) to improve the Port District for port purposes; (4) to cooperate with other bodies interested in the Delaware River and Port District; (5) to construct bridges and tunnels across or under the Delaware River; (6) to promote the Delaware River as a highway of commerce; and (7) to make studies and recommendations for the improvement of commerce facilities on the Delaware River. For its authorized purposes the Commission is empowered to: (1) have legal existence with all the rights and liabilities thereto; (2) exercise eminent domain in the Port District; (3) determine the location and character of all improvements or facilities within its jurisdiction; and (4) acquire and operate any project or facility of commerce. (Smith-Florida)
W70-03573

DELAWARE RIVER PORT AUTHORITY (REVENUE).
Pa Stat Ann tit 36, secs 3503, 3504 (1961), as amended, (Supp 1969).

Descriptors: *Pennsylvania, *Interstate commissions, *Delaware River, *Interstate compacts, Interstate rivers, River basin commissions, River basin development, Water resources development, Rivers, Bridges, Bridge construction, Communication, Navigation, Transportation, Eminent domain, Regulation, Cities, Tunnels, Tunnel construction, Legislation.

The control, operation and collection of tolls and other revenue of the existing bridge across the Delaware River belong to the Commission, but the Commission is liable to Pennsylvania, New Jersey and Philadelphia for certain named moneys. The Commission is authorized to make and enforce such rules and regulations and to collect such tolls and other charges in connection with properties it controls as it may deem necessary or proper. The Commission shall make annual reports to the member states. The Commission upon written consent of the Governors, is empowered to acquire the Tacony-Palmyra Bridge with any approaches thereto. The Commission shall not erect any new facility without prior approval of the Governors of both states. Certain local limitations on bridge and tunnel construction are imposed. The Commission is empowered to construct and operate a bridge or tunnel for vehicular traffic at named locations and to exercise eminent domain to obtain private or public property for such projects. The Commission is empowered to construct, rehabilitate and operate ferries across the Delaware River within the Port District. Public utilities' rights of way shall be relocated if condemned by the Commission. (Smith-Florida)
W70-03574

REMOVAL OF MILLDAMS.
Ohio Rev Code Ann secs 6155.01 thru 6155.13 (Page 1953).

Descriptors: *Ohio, *Milldams, *Administrative agencies, Assessments, Streams, Water supply, Benefits, Costs, Legal aspects, Public health, Damages, Land tenure, Cost allocation, Local governments, Structures.
Identifiers: *Passage of water, Removal.

Procedures required for the removal of milldams are described. Two-thirds of the affected landowners must file a petition with the county auditor and a surety bond to pay expenses if the county board of commissioners refuses the petition. Notice of hearings is required. The board of commissioners shall view the premises and shall determine if the improvement and removal of the milldam is conducive to public health, convenience, or welfare. If it grants the petition, the board shall negotiate for the purchase of the milldam. The board shall equitably apportion the costs of purchase and removal to each of the petitioners and landowners benefited by the removal. Upon failure to agree with an owner of a milldam, application for damages may be made. Real estate of the benefited landowners shall be assessed to pay the costs of removal. (Duss-Florida)
W70-03576

MUNICIPAL CORPORATIONS (PUBLIC SERVICES).

Ohio Rev Code Ann secs 735.02, 735.32 (Page 1953).

Descriptors: *Ohio, *Cities, *Public utilities, *Maintenance, Legislation, Local governments, Projects, City planning, Administration, Utilities, Roads, Engineering personnel, Repairing, Mechanical engineering, Sewers, Drains, Ditches, Streams, Sewage, Construction, Administrative agencies, Legal aspects, Water management (Applied), Channels, Water courses (Legal).

The director of public service manages and supervises all public works of the city. The director supervises the improvement and repair of wharves, docks, landings, bridges, aqueducts, sewers, drains, ditches, culverts, ship channels, streams, and watercourses. The director manages municipal water undertakings of the city and sewage disposal plants. The street commissioner, or an engineer if provided, supervises the improvement of streets and other enumerated activities. (Powell-Florida)
W70-03579

PUBLIC UTILITIES AND CARRIERS.
Tenn Code Ann secs 65-2201 thru 65-2204 (1956).

Descriptors: *Tennessee, *Public utilities, *Dams, *Navigable waters, Legislation, Construction, Eminent domain, Streams, Rivers, Water consumption, Industrial water, Domestic water, Water control, Hydroelectric plants, Water works, Water conveyance, Electric power production, Navigation, Boats, Canals, Reservoirs, Ponds, Locks, Sluices, Diversion, Legal aspects.
Identifiers: *Sluiceway.

Gas and electric corporations furnishing light, heat, and power generated or produced from stream power or water power obtained by a dam across any stream of water have the power of eminent domain. They may use, employ, and divert necessary water flowing in and running into a stream or watercourse. They may also use lands necessary in establishing and maintaining their power houses, canals, flumes, conduits, pipelines, reservoirs, ponds, and dams. A sluiceway, lock or other fixture sufficient to permit logs, timber, lumber, and boats to pass around, through or over a dam must be maintained in connection with the corporation's dam in navigable waters. Plans and details for work on dams in navigable waters must be submitted to the Secretary of the Army for his approval before work is commenced. Construction in navigable waters is subject to the supervision and approval of the Engineer Officer of the United States Army in charge of the locality. (Powell-Florida)
W70-03586

WATER AND WATERWORKS COMPANIES.

Tenn Code Ann secs 65-2701 thru 65-2704, 65-2709 (1956).

Descriptors: *Tennessee, *Public utilities, *Condemnation, *Water polution, Eminent domain, Legal aspects, Legislation, Cost repayment, Right-of-way, Condemnation value, Water control, Water conveyance, Watercourses (Legal), Streams, Riparian rights, Domestic water, Municipal water, Riparian land, Riparian waters, Canals, Conduits, Ponds, Dams, Reservoirs, Water consumption (Excludes consumptive use), Water allocation (Policy), Water distribution (Applied), Environmental sanitation.

Any water company is empowered to acquire, by purchase, condemnation, or other proper method, the right to use and divert the necessary water flowing and running into any stream or watercourse. The water company may also take land, water, riparian rights and rights-of-way necessary for establishing and maintaining its power houses, canals, flumes, conduits, pipelines, ponds, dams, reservoirs, and other works. Water companies, incorporated under Tennessee laws and having contracts to supply water to public charitable institutions may condemn springs, creeks, waters and riparian rights for the purpose of furnishing such water supply. The water company must compensate the owners for property condemned and may give a bond pending assessment of damages resulting from condemnation of water or rights. It is unlawful to corrupt any stream or reservoir used by a corporation for water supply. (Powell-Florida)
W70-03587

DIVISION OF WILDLIFE.
Ohio Rev Code Ann secs 1531.06, 1531.07, 1531.11, 1531.14, 1531.15, 1531.24 (Page 1964), as amended, (Supp 1970), sec 1531.29 (Page Supp 1970).

Descriptors: *Ohio, *Natural resources, *Wildlife management, *Wildlife conservation, Legislation, Legal aspects, Water rights, Water conservation, Wastes, Water pollution control, Fish hatcheries, Regulation, Recreation, Fishing, Streams, Lakes, Reservoirs, Clams, Mussels, Crayfish, Fish, Frogs, Turtles, Investigations, Ponds, Rivers, United States, Wildlife, Water resources development, Fish stocking.

The Chief of the Division of Wildlife may acquire lands or surface rights upon lands or waters for wildlife management, preservation and propagation, and for outdoor activities such as hunting and fishing. The Chief is empowered to make regulations to protect these acquisitions from pollution and waste and to provide for the taking of wildlife on the acquired property. All lakes, reservoirs, and state lands dedicated to public recreational use will be placed under the supervision and control of the Chief. No person may take, possess, buy, or sell any clams, mussels, crayfish, fish, or frogs contrary to a Division regulation. Employees of the Division may enter upon private land to conduct fish or game research, fish restoration, or fish restocking. The Division may take fish at any time or place and in any manner stock hatcheries, ponds, lakes, or rivers, or exterminate rough fish. The Division may set aside any waters for the propagation of fish. The United States Commissioner of Fisheries may operate and maintain fish hatcheries within the state. He may conduct investigations and fish cultural operations. No person may discharge garbage, rubbish, or other unsightly or unsanitary wastes into any state owned or controlled watercourse. This section does not apply either to discharge of wastes under authority of a valid permit, or to pollution of waters which do not join natural surface or underground waters. (Keith-Florida)
W70-03588

BRIDGE COMPANIES (CONSTRUCTION OF BRIDGES AND INTERFERENCE WITH NAVIGATION).
Tenn Code Ann sec 54-1803 (1968).

Descriptors: *Tennessee, *Bridges, *Bridge design, *Navigation, Design standards, Navigable waters, Streams, Boats, Structures, Construction, Legislation, Bridge construction, Standards.
Identifiers: Obstruction to navigation.

Bridge companies may adopt design standards and specifications to insure that bridges shall be safely built and suitable for the intended traffic. Bridges across navigable streams shall not necessarily interfere with navigation, and shall have enough draw or be sufficiently high to allow the passage of boats under them. (Duss-Florida)
W70-03589

GAME AND FISH COMMISSION (GAME AND FISH MANAGEMENT AND CONSERVATION).

Tenn Code Ann secs 51-101 thru 51-121 (1966).

Descriptors: *Tennessee, *Administrative agencies, *Fish, *Fish management, Fish conservation, Fish hatcheries, Commercial fishing, Fish stocking, Bodies of water, Ponds, Fishing, Fisheries, Regulation, Legislation, Financing, Wildlife conservation, Wildlife management, Game birds, Fur-bearing animals, Hunting, Conservation, Wildlife.
Identifiers: *Fish propagation, *Preserves, Reservations, Nursery ponds, Penalties (Criminal).

The State Game and Fish Commission is herein created. The operation of the Commission is provided. The Governor shall appoint Commissioners. The Commission has full and exclusive jurisdiction of the duties and functions relating to fish, game, and wildlife. It is the Commission's duty to protect, propagate and preserve game, fish, fur-bearing animals and wildlife of the state. The Commission is authorized to acquire lands and waters suitable for; fish hatcheries, nursery ponds, or game farms; animal restoration, propagation, protection or management; and public hunting, fishing, or trapping areas. The Commission may acquire species of animals for these purposes and control undesirable species. It may enter into cooperative agreements with landowners to further wildlife management. It may enter into agreements with educational institutions and other governmental agencies to promote wildlife management and conservation. Procedures are outlined for the appointment and compensation of a Director for the Commission and of personnel needed for the administration of game and fish laws. The powers and duties of these officers are described. Financing of the various activities of the Commission and its personnel is described. (Duss-Florida)
W70-03590

HEALTH AND SAFETY (MALARIA).

Tenn Code Ann secs 53-801 thru 53-809 (1966).

Descriptors: *Tennessee, *Impounded waters, *Mosquitoes, *Public health, Permits, Impoundments, State governments, Legislation, Administration, Administrative agencies, Regulation, Diseases, Bayous, Afterbays, Obstruction to flow, Aedes species.
Identifiers: Nuisances.

Impounded water is defined as a body of water of less than one acre which has collected under other than natural conditions. Any person proposing to impound water must obtain a permit for impoundage construction from the Commissioner of the State Department of Public Health. Application is to be made upon a special form, accompanied with a description of the project, its purpose, location and a plat of the general area. Application to permit actual impoundage of water must be made to the Commissioner after construction is complete. The Commissioner shall make rules and regulations regarding impounded water to be carried out by those responsible for the impounded area. The Commissioner must inspect impounded waters to see if such is conducive to the breeding of malaria or other disease-carrying mosquitoes. If conducive to such breeding, the condition must be corrected by the one responsible for the impoundage area. Failure to do so is a misdemeanor and punishable by fine. If convicted three times for violation of this act, the impounded area may be abated as a nuisance at the cost of the owner. (Barnett-Florida)
W70-03591

PUBLIC MILLS (FREE PASSAGE OF WATER THROUGH MILL SLUICES).
For primary bibliographic entry see Field 04A.
W70-03592

CRIMINAL OFFENSES: ARSON AND FRAUD.

Tenn Code Ann secs 39-504, 39-1908, 39-1909 (1956).

Descriptors: *Tennessee, *Bridges, *Vessels, *Insurance, Legal aspects.

It is a felony to willfully and maliciously burn any bridge or watercraft. (Dearing-Florida)
W70-03593

WATERS AND WATERCOURSES: CRIMINAL OFFENSES.
Tenn Code Ann secs 2205, 2206 (1956).

Descriptors: *Tennessee, *Water works, *Water pollution, *Legal aspects, Pipes, Pumps, Reservoirs, Streams, Equipment, Domestic water, Industrial water, Standpipes, Water supply, Legislation.

It is a misdemeanor to: willfully injure the pipes, pumps, reservoirs, tanks, or other apparatus of any waterworks; disturb or pollute the waters of any waterworks by any willful acts; or to pollute any stream supplying water to any such water plant. (Dearing-Florida)
W70-03594

CRIMINAL OFFENSES: NUISANCES.
Tenn Code Ann secs 39-2901, 39-2904 (1956).

Descriptors: *Tennessee, *Obstruction to flow, *Water pollution, *Legal aspects, Navigation, Rivers, Streams, Ponds, Water pollution effects, Water pollution sources, Legislation, Navigable waters, Pollutants.
Identifiers: Obstruction to navigation, Nuisance.

It is a public nuisance to: (1) obstruct or impede the passage of any navigable river or collection of water; (2) cause any filth or noisome substance to collect or remain in any place to the prejudice of others; or (3) to corrupt or render impure the water of any river, stream or pond. (Dearing-Florida)
W70-03595

WATERS AND WATERCOURSES: CRIMINAL OFFENSES.

Tenn Code Ann secs 39-4214, 39-4215 (1956).

Descriptors: *Tennessee, *Fishing gear, *Conduits, *Legal aspects, Fish, Nets, Commercial fishing, Pipes, Water works, Permits, Fishing, Regulation, Legislation.
Identifiers: Penalties (Criminal).

Tampering with, or removing fish from any fishing device of another is declared to be a misdemeanor. It is also a misdemeanor to make any tap or connection with any water main or pipes without first obtaining a written permit from the owner. (Dearing-Florida)
W70-03596

WATERS AND WATERCOURSES: CRIMINAL OFFENSES.

Tenn Coade Ann secs 39-4801 thru 39-4811 (1956), as amended, (Supp 1969).

Descriptors: *Tennessee, *Legal aspects, *Regulation, *Structures, Springs, Wells, Ponds, Reservoirs, Canals, Dams, Docks, Water works, Bridges, Water conveyance, Culverts, Navigation, Channels, Surveys, Pipes, Vessels, Levees, Watercourses, Withdrawal, Legislation, Navigation, United States, Floods, Flooding.
Identifiers: *Causeways, United States Coast and Geodetic Survey, Penalties (Criminal), Penalties (Civil), Obstruction to navigation.

The following acts are declared to be misdemeanors: (1) to injure any spring, well, or water used by any worshipping assembly or belonging to another person; (2) to maliciously draw off the water from another's millpond, reservoir, canal, trench or pond; (3) to maliciously injure any dam, lock, canal, trench, reservoir or waterworks; (4) to maliciously destroy another's fixtures for the conveyance of water; (5) to interfere with any navigation structure, or to erect or maintain an obstruction to navigation; (6) to injure or remove any property of the United States Coast and Geodetic Survey; (7) to maliciously injure or let loose any vessel of another; (8) to travel on any levees except as designated for public travel; or (9) to maliciously injure any bridge, causeway, or tollgate. It is a felony to cut or to produce a break in a levee so as to flood protected lands. It is further declared a major misdemeanor to fraudulently tamper with serial numbers on boats or to knowingly buy, sell, or possess a boat whose serial numbers have been tampered with. Civil liability is also provided for various of the above offenses. (Dearing-Florida)
W70-03597

NATIONAL FORESTS, PARKS AND DEVELOPMENT PROJECTS.

Tenn Code Ann secs 11-1001 thru 11-1006 (1956).

Descriptors: *Tennessee, *Federal government, *Tennessee River, *National forests, Legal aspects, Legislation, Projects, Parks, Land use, Streams, Bridges, Boats, State governments, Land, River basins, State jurisdiction, Administrative agencies, Eminent domain, Compensation.
Identifiers: Tennessee River Basin.

The United States is authorized to acquire such land as the federal government, the State Forester, and the Governor consider necessary for the establishment and extension of national forests and parks and the improvement and development of the Tennessee River Basin. The state of Tennessee retains its title, ownership and jurisdiction over all bridges, ferries, and streams and the right to locate, relocate and reconstruct bridges and ferries over such streams. Federal agencies acquiring lands for public improvement have no right to destroy or impair the use of any bridge or ferry without first compensating the owner thereof. (Powell-Florida)
W70-03598

LAND FOR INSTITUTIONAL WATER OR SEWAGE SYSTEM.

Tenn Code Ann sec 12-109 (1956).

Descriptors: *Tennessee, *Riparian rights, *Water rights, *Administrative agencies, Legal aspects, State governments, Land use, Legislation, Pipelines, Water supply, Drainage systems, Land, Sewage systems, Institutions, Water works, Condemnation, Easements, Right-of-way.

The state of Tennessee, acting through the department or agency supervising penal, charitable, reformatory, or educational institutions, may acquire all necessary land with interests therin, including flowage rights, rights of riparian owners on any tennessee stream and easements for water works or sewage disposal pipe lines for the use of such institution. (Powell-Florida)
W70-03599

CONCURRENT JURISDICTION OF THE MISSISSIPPI RIVER.
Tenn Code Ann secs 4-102, 4-103 (1956).

Descriptors: *Tennessee, *Boundaries (Property), *Jurisdiction, *Mississippi River, Legislation, Missouri, Arkansas, Legal aspects, Rivers, State jurisdiction, Meanders, Banks, Boundary disputes, Supervisory control (Power), Water rights, Political aspects.
Identifiers: Concurrent jurisdiction.

Tennessee has concurrent jurisdiction over the waters of any river which forms a common boundary with another state. The criminal jurisdiction of the state of Tennessee is extended to the west bank of the Mississippi River and extends across the Mississippi River where it flows parallel to the boundary of Tennessee. Thus, the states of Tennessee, Arkansas, and Missouri have concurrent criminal jurisdiction over those parts of the Mississippi River which lie opposite them. This section shall become effective as to the states of Arkansas and Missouri when these states pass similar legislation. (Schram-Florida)
W70-03600

JURISDICTION OVER BOUNDARY WATERS.

Tenn Code Ann sec 5-102 (1956).

Descriptors: *Tennessee, *Jurisdiction, *Boundaries (Property), *Legal aspects, Water law, Legislation, Local governments, Watercourses (Legal), Streams, Boundary disputes, Bodies of water, Ownership of beds, Supervisory control (Power), Water rights.
Identifiers: *Concurrent jurisdiction.

Counties that are bounded by a stream or other waters shall have concurrent jurisdiction over the whole of the waters lying between them. (Schram-Florida)
W70-03601

SUPERVISION OF LOCAL IMPROVEMENTS.

Tenn Code Ann sec 5-521 (1956).

Descriptors: *Tennessee, *Local governments, *Roads, *Watercourses (Legal), Legislation, Road construction, Construction, Maintenance, Supervisory control (Power), Legal aspects, Jurisdiction, Repairing.
Identifiers: *Ferries, *Improvements.

The establishment and general supervision of roads and ferries, watercourses, and local improvements are intrusted to the county court and are county purposes. (Schram-Florida)
W70-03602

BRIDGES AND CROSSINGS.

Mo Ann Stat secs 229.150, 229.160 (1952).

Descriptors: *Missouri, *Bridges, *Highways, *Ditches, Drains, Legislation, Administrative agencies, Drainage, Damages, Construction, Maintenance, Right-of-way, Landscaping, Shrubs, Vegetation establishment, Drainage water.

All driveways or crossings over ditches connecting highways with private property shall be made under the supervision of the overseer or commissioners of the road districts. It is a punishable misdemeanor for any person to willfully obstruct or damage any public road by: (1) obstructing the side, cross drainage, or ditches; (2) turning water upon such road or right-of-way; (3) depositing any refuse or debris on any public road or in adjacent ditches; (4) planting any hedge or erecting any advertising sign within the lines established for such roads. The road overseer or county highway engineer who finds any road so obstructed shall notify the violator to remove the obstruction. Operators of threshing machines, sawmills, and tractors when corssing public bridges are required to lay down planks not less than one foot wide and three inches thick on the floor of the bridge. (Schram-Florida)
W70-03605

CONSTRUCTION AND MAINTENANCE OF BRIDGES.
Mo Ann Stat secs 231.220, 231.230 (1952).

Descriptors: *Missouri, *Bridges, *Local governments, *Bridge construction, Maintenance, Repairing, Bids, Contracts, Costs, Construction, Legislation, Structures, Engineering structures, Roads, Supervisory control (Power).

The township board of directors shall construct and repair all bridges in their district costing less than one hundred dollars. They shall make all necessary repairs costing less than twenty-five dollars upon bridges that are built within the township. Whenever it is necessary for the board to build a bridge which will cost more than twenty-five dollars, the board may advertise for bids by giving notice. Whenever it is necessary for any township to build a bridge costing more than one hundred dollars, the township board of directors shall present a certified statement of the amount necessary for construction to the county court. If deemed proper, the county court shall cause the bridge to be built by contract as provided by law. (Schram-Florida)
W70-03607

BRIDGES (CONSTRUCTION OF BRIDGES BY COUNTY COURTS).
Mo Ann Stat secs 234.010 thru 234.090 (1952).

Descriptors: *Missouri, *Bridges, *Bridge construction, Local governments, Culverts, Concrete construction, Repairing, Maintenance, Supervisory control (Power), Administrative agencies, Legislation, Damages, Compensation, Financing, Costs, Participating funds, Bridge failure, Taxes, Assessments, Construction costs, Rivers, Streams, Highways.

Each county court shall determine whether the county court or road districts shall build and maintain bridges. The construction of all masonry or concrete culverts and bridges and all bridges costing more than fifty dollars shall be under the supervision of the county highway engineer. Whenever a county bridge is badly damaged by floods or becomes dangerous to public travel, the county highway engineer, with the consent of one or more county judges, may contract to have the bridge repaired. The county court shall allow a reasonable compensation for such repairs. The control and management of toll bridges and roads constructed by now defunct corporations shall be vested in the local county court. Taxpayers may petition for the construction of bridges in any township. County courts may unite for the purpose of building bridges beneficial to the adjoining counties. The procedure for building bridges uniting counties is provided. The procedures for constructing and financing bridges between Missouri and adjoining states are detailed. (Schram-Florida)
W70-03608

ANALYSIS OF MANAGERIAL, FINANCIAL, AND REGULATORY FUNCTIONS OF REGIONAL WATER RESOURCES AUTHORITIES AND OTHER INSTITUTIONAL ARRANGEMENTS.
Booz-Allen and Hamilton, Inc., Washington, D.C.
For primary bibliographic entry see Field 06B.
W70-03611

A UNITED STATES POLICY FOR THE WET FRONTIER,
Theodore F. Stevens.
Nat Res Lawyer, Vol 2, No 4, p 347-351, Nov 1969. 5 p.

Descriptors: *Continental shelf, *Continental slope, *Law of the sea, *United States, Marine geology, Legal aspects, Easements, Federal jurisdiction, International law, Commercial fishing, Boundaries (Property), Water resources, Mineralogy, Fishing, United Nations, Oceans, Oil fields, Exploration, Federal government.

Suggestions are offered for modifying the United States' present policy regarding use of offshore resources. This policy rests upon an interpretation of findings made by the 1958 Geneva Convention on the Continental Shelf. Present United States' policy is considered to be too restrictive. It is urged that American jurisdiction should extend to the limits of the 'continental terrace', which includes the continental slope as well as the continental shelf. The United States should assert exclusive jurisdiction over submarine mineral development and over management and disposition of sea food resources within the limits of the terrace. The United States has adopted United Nations' guidelines which give sovereign rights to a coastal nation for limited exploration and exploitation of an area outside the territorial sea extending to a depth of 200 meters. It is concluded that the United States ought to have this definition of the exploitability modified to embrace the entire continental terrace. It is further concluded that it is in the best interests of the United States to claim exclusive fishery rights in the waters superjacent to the continental terrace and to seek international recognition of this claim. (Barnett-Florida)
W70-03627

WATER RESOURCES (APPROPRIATION OF WATER RESOURCES AND RIGHTS).
Miss Code Ann secs 5956-01 thru 5956-08, 5956-10 thru 5956-24 (Supp 1968).

Descriptors: *Mississippi, *Appropriation, *Beneficial use, *Prior appropriation, Legal aspects, Administration, Administrative agencies, State governments, Water rights, Preferences (Water rights), Relative rights, Alteration of flow, Diversion, Water users, Dams, Reservoirs, Water levels, Diversion dams, Interstate compacts, Surface waters, Water conservation, Water utilization, Permits, Legislation, Water districts.

To conserve and to put the water resources of Mississippi to their highest beneficial use, all natural bodies of water are made subject to appropriation and placed under the control and development of the state. The Mississippi Board of Water Commissioners is created to administer the act which deals with: (1) the definition, acquisition, and termination of water rights; (2) application for appropriation of water; (3) the employment of a water engineer; (4) powers and duties of the Board; (5) inventory of water resources; (6) cooperation of the Board with other agencies; (7) creation of water districts; (8) unappropriated waters; (9) applications for permits to acquire appropriate rights and to construct appropriation diversion works; (10) construction of dams and reservoirs; (11) compacts and agreements; (12) surveys; and (13) diversion of watercourses. Surface water, domestic uses, municipal use, beneficial use, appropriator, appropriation, watercourse, established average minimum flow, and established average minimum lake levels are defined. (Marsee-Florida)
W70-03635

WATER RESOURCES (BOARD OF WATER COMMISSIONERS).
Miss Code Ann secs 5956-01 thru 5956-08, 5956-10 thru 5956-14 (Supp 1968).

Descriptors: *Mississippi, *Appropriation, *Administrative agencies, *Beneficial use, Prior appropriation, Legal aspects, Administration, State governments, Water rights, Preferences (Water rights), Relative rights, Water users, Dams, Water levels, Surface waters, Water conservation, Water utilization, Leadership, Domestic water, Spring waters, Water districts.

All natural bodies of water are subject to appropriation and placed under the control and development of the state. However, ground or subterranean water rights or usage are not affected. No right to appropriate or use water subject to appropriation shall be acquired except upon compliance with this act. However, nothing herein shall interfere with the customary use of water for domestic purposes nor prevent a landowner from using a spring arising on his land. Moreover, any person may construct a dam across streams having the minimum flow specified herein. Water appropriation shall be equal to other property rights and may only be terminated as provided herein. To administer this act a Board of Water Commissioners is created. Its powers and duties shall be to: (1) employ a water engineer; (2) cooperate with other agencies; (3) inventory water resources; (4) establish the rights of present beneficial water users; and (5) divide the state into water districts. Surface water, appropriation, watercourse and domestic use are defined. (Marsee-Florida)
W70-03636

WATER RESOURCES (APPLICATIONS TO APPROPRIATE).
Miss Code Ann secs 5956.15-5956.24 (Supp 1968).

Descriptors: *Mississippi, *Appropriation, *Administrative agencies, *Beneficial use, Prior appropriation, Legal aspects, Administration, State governments, Water rights, Preferences (Water rights), Relative rights, Alteration of flow, Diversion, Water users, Dams, Reservoirs, Diversion dams, Interstate compacts, Surface waters, Water conservation, Water utilization, Permits, Watercourses (Legal), Legislation, Water districts.

An application must be made to the Board of Water Commissioners in order to acquire an appropriate right to any surface streams, lakes, or other watercourses of Mississippi for beneficial use. Upon examining the maps, plats and other information filed with the application, the Board may approve the same and issue a permit authorizing the construction of diversion works to perfect the appropriation. Persons desiring to construct dams or reservoirs on any watercourse specified herein must obtain a written statement from the Board that such construction will not affect plans for the proper utilization of the water resources of the state. The Board may also: (1) enter into compacts and agreements concerning interstate watercourses; (2) enter upon lands to make surveys; and (3) regulate the diversion of watercourses. The Board shall aid in the distribution of water in accordance with court orders. (Marsee-Florida)
W70-03637

FISH TRAPS: LICENSING AND REGULATION.
R I Gen Laws Ann secs 20-18-2 thru 20-18-20 (1968).

Descriptors: *Rhode Island, *Fishing gear, *Commercial fishing, *Trapping, Fish, Fishing, Permits, Equipment, Legal aspects, Administrative agencies, State governments, Jurisdiction, Regulation, Wildlife management, Water conservation, Inspection, Nets, Weirs, Fish harvest, Legislation, Control, Fish conservation, Fish management.
Identifiers: *Fish traps.

Provisions of this act regulate the use of fish traps in Rhode Island waters and govern the licensing of persons erecting or maintaining such traps. The Director of Natural Resources is empowered to make rules and regulations concerning fish traps and to control the issuance of licenses. The superior court is given jurisdiction to enforce the provisions of this act and the regulations promulgated by the Director. 'Fish trap' includes floating traps, weirs, pounds, nets, or other devices to catch fish. (Marsee-Florida)
W70-03638

SHAD FISHING IN THE DELAWARE RIVER, BAY, AND TRIBUTARIES.

Pa Stat Ann tit 30, secs 431-438, 441, 461 (1958).

Descriptors: *Pennsylvania, *Delaware River, *Permits, *Fish conservation, Regulation, Fishing gear, Nets, Fyke nets, Gill nets, Trapping, Legislation, Legal aspects, State governments, Fish, Administrative agencies, Interstate compacts, Federal government, New York, Delaware, New Jersey, Fishing, Rivers, Bays, Tributaries, Fish management.
Identifiers: *Shad fishing.

In accordance with the purposes of the Atlantic States Marine Fisheries Compact and in order to restore shad in the Delaware River, this act establishes a license system designed to control increases in fishing pressures in the Delaware. Licensing procedures are set forth. Only the fishing gear designated herein may be used to take shad in the Delaware River, Delaware Bay, and their tributaries. Permitted gear is regulated and includes the following: (1) haul seines; (2) fyke or hoop nets; (3) stake gill nets, either stake or anchored; (4) drift gill nets; and (5) hand lines, including rod and reel. Closed seasons are established, and the location of nets governed. The Pennsylvania Fish Commission is authorized to confer with New York, New Jersey, Pennsylvania, and Delaware officials and may enter agreements with respect to the coordination of research, enforcement, and other operations necessary to joint shad management. The Pennsylvania Fish Commission is authorized and directed to cooperate with the federal government in those fish restoration and management projects contemplated by specified act of the United States Congress. (Marsee-Florida)
W70-03639

DAMS AND BRIDGES (PROCEDURES REGARDING WATER POWER PERMITS).

Wis Stat Ann secs 31.095-31.17 (1967), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Permits, *Dam construction, *Bridges, Administrative agencies, Legislation, State governments, Local governments, Electric power, Powerplants, Hydroelectric plants, Regulation, Boundaries (Property), Operation and maintenance, Utilities, Dams, Resources, Public utilities, Reservoirs.

Acquiescence to rates set by the Department of Resources Development and the Public Service Commission for electric power distributed to users within the state is a condition precedent to the issuance of a water power permit. Permits will be void unless the dams which they authorize are completed within five years. Necessary and reasonable two-year extensions may be given. The grantee of a permit must submit a map and profile of the plans and specifications of the structure to the Department. The Department may reject, modify, or approve such plans. A verified statement of compliance with those plans must be submitted to the Department within ten days of the dam's completion. With the Department's permission, existing dams may be raised or enlarged. No permit will be granted when there is no proof of ability to operate and maintain the proposed dam or if objections are filed by the municipalities in which the dam is to be located. Existing dams may be acquired by any corporation engaged in the business of furnishing power to the public. (Barnett-Florida)
W70-03640

PUBLIC DOMAIN AND TRUST FUNDS (DAMS AND BRIDGES).
Wis Stat Ann secs 31.18-31.26 (1967), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Permits, *Bridges, *Dams, Hydroelectric power, Administrative agencies, State governments, Legislation, Local governments, Legal aspects, Navigable waters, Nonnavigable waters, Sluices, Dam construction, Dam failure, Hydraulic structures, Hydroelectric plants, Regulation, Inspection, Navigation, Detention reservoirs, Safety, Operation and maintenance.
Identifiers: Nuisances.

Various obligations with regard to public safety and convenience must be met by those who own and operate bridges and dams within the state. Any action concerning construction, operation, and maintenance of these structures is subject to prior permission of the Department of Resources Development. Dams capable of producing a minimum of 750 horsepower shall be inspected yearly. At other times, inspections shall be made upon allegations by a mayor or village president that a dam or reservoir is unsafe and a danger to the public. An annual inspection fee shall be paid by bridge and dam owners. Transfers of permits are controlled by the Department and the duration of contracts under such permits for the distribution of power is limited. Any dam maintained as an unlawful combination to restrict hydroelectric power may be taken over by the state through receivership proceedings. Private citizens may build bridges on navigable waters with the permission of the Department. Bridges and dams not built in accord with this act are public nuisances. Liens may be imposed upon bridges and their approaches to secure judgments obtained as a result of damage caused by their operation. (Barnett-Florida)
W70-03641

HIGHWAYS, BRIDGES, DRAINS (MISCELLANEOUS HIGHWAY PROVISIONS).

Wis Stat Ann secs 86.20-86.23 (1957), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Bridge construction, *Bridges, *Boundaries (Property), Legislation, Local governments, Abutments, Piers, Railroads, State governments, Navigable waters, Interstate rivers, Rivers, Legal aspects, Condemnation, Administrative agencies, Financing, Cities, Public utilities, Transportation.
Identifiers: *Toll bridges, Approaches.

Any corporation authorized by Congress to build and maintain a bridge over navigable boundary waters of Wisconsin shall have all the rights and powers, with respect to entry and acquisition of real estate, that railroad corporations now possess. Any county, town, or village bordering navigable waters which form a boundary line of this state may construct a foot and vehicular toll bridge across such waters. The governing bodies of such municipalities must adopt a resolution authorizing such construction and specifying the method of financing. Financing may be either through the proceeds of bonds, taxation, or from the general fund. Twenty percent of the electorate may file a petition requesting that the question of acquisition of such toll bridges be submitted to them. Bonds are to be repaid solely from the revenues of bridge operation. For purposes of management, two or more bridges may be combined as a single public utility. Any bridge corporation franchised to construct, operate, or maintain a railroad bridge or a passageway across waters forming a boundary line of this state must maintain such bridge in accessible condition with serviceable approaches. All swing or drawbridges built jointly by two municipalities shall be maintained by each in proportion to the cost of construction borne by each. (Barnett-Florida)
W70-03642

6F. Nonstructural Alternatives

LINCOLN'S EXPERIENCE IN REGULATING FLOOD PLAIN DEVELOPMENT,
Lincoln City-Lancaster County Planning Commission, Nebr.
James H. Schroeder.
In: Flood Plain Management, Iowa's Experience, ed. by Merwin D. Dougal (Ames, Iowa: Iowa State University Press, 1960), Chapter 20, p 237-245. 1 fig, 3 ref.

Descriptors: *Flood plains, *Regulation, Management, Flood plain zoning, Utilities, City planning, Multiple-purpose projects, Parks, Watershed management, Administration.

In the past eight years much has been done in the form of corrective and preventive flood measures within the Lincoln area. Comprehensive plans developed in 1952 and in 1960 have recognized the flood problem. The 1960 comprehensive plan pertains both to the city area and to the whole of Lancaster County. It includes limiting the development allowed in the flood plain area. This is done in two ways: (1) lands which lie in the flood plains are designated to be part of the community's park system, and (2) where it is not possible to include the land in the park system, the development of the land within the flood plain is kept at an absolute minimum. Lincoln enforces the latter by controlling the expansion of municipal utilities, i.e. not expanding utilities into areas subject to inundation by the 100 year flood. In addition, corrective flood control measures have been installed. Lincoln is included in the Salt Creek Watershed District formed in 1960 and has benefited from the construction of nine large dams, and channel improvements along Salt Creek. The author emphasizes the need for public and administrative cooperation, sound technical planning and public support to implement a successful comprehensive program for a city. (Marriott-Chicago)
W70-03341

THE ROLE OF OPEN SPACES IN FLOOD PLAIN MANAGEMENT,
Commissioner of Parks and Public Property, Cedar Rapids, Iowa
Donald K. Gardner.
In: Flood Plain Management, Iowa's Experience, ed. by Merwin D. Dougal (Ames, Iowa: Iowa State University Press, 1969), Chapter 12, p 137-146. 4 fig, 12 ref.

Descriptors: *Flood plains, *Management, *Parks, *Flood control, Multiple-purpose projects, Nonstructured alternatives, Recreation facilities, Water sports, Golf courses, Water resources development, Preservation.
Identifiers: *Open space, *Cedar Rapids, (Iowa).

Using Cedar Rapids, Iowa as an example this article emphasizes the need for a balanced allocation of land use in urban areas, and the compatibility of open-space needs with concepts of optimum flood plain utilization and minimum flood plain occupancy. It is accepted that open-space is necessary for parks and recreational facilities. Flood plains provide open space, good recreation possibilities, are cheaper to acquire than other land sites, and create hazardous situations when used for industry, commerce and housing. A program is proposed which would include acquisition of a greenbelt which would encompass at least the design floodway, natural or improved, covering an area of twenty-five miles and 2,000 to 3,000 acres of land. Where high population densities were anticipated, this greenbelt would be expanded to include areas for playgrounds, athletic uses and major picnic centers. Some of these uses have been experimented with already with good results. Special studies of the three creeks which affect the city have been made so that the city administration has sufficient information in formulation of flood plain policy. Other aids in an open-space program are the Department of Housing and Urban Development and the Land and Water Conservation Fund program of the Department of Interior Bureau of Outdoor Recreation. (Marriott-Chicago)
W70-03342

EXTENT AND FREQUENCY OF INUNDATION ON THE PERKIOMEN CREEK FLOOD PLAIN FROM GREEN LAND RESERVOIR TO THE SCHUYLKILL RIVER (NEAR OAKS, PENNSYLVANIA),
Geological Survey, Harrisburg, Pa.
For primary bibliographic entry see Field 02E.
W70-03458

6G. Ecologic Impact of Water Development

WATER AND MAN: A WORLD VIEW,
Geological Survey, Washington, D.C. Water Resources Div.
Raymond L. Nace.
Paris, France, UNESCO, 1969. 46 p, 7 photo.

Descriptors: *Water resources development, *International Hydrological Decade, *Reviews, Water management (Applied), Water quality, Environmental effects, Environment, Ecology, Planning.
Identifiers: IHD programs.

Civilization's dependence on the world's water resources is discussed. Not only does our civilization depend on water availability, but water resources are profoundly affected by civilization. Water development and water policies always have been important, as is evident from the many physical and administrative measures to control its distribution and use, beginning with the ancient Sumerians of Mesopotamia and becoming ever more complex with the passage of time. Even so, water problems are becoming increasingly critical in many regions, including areas in developed countries where water is relatively abundant. The reason is that in many regions problems are less apt to relate to water quantity than to its quality. Broadly stated, water problems are few but basic: distribution in space (too much or too little); distribution in time (too much in some seasons or years and not enough in others); chemical quality (too highly mineralized; lacking in desirable minerals; containing deleterious minerals); and pollution. The International Hydrological Decade was established, starting in 1965, to study world water problems. The general purpose of the IHD is to accelerate scientific study of water resources and water regimes in order to improve water conservation, management and use. The bulk of the IHD programe consists of activities by participating States within their own territories, catalyzed, co-ordinated and supplemented by international intergovernmental organizations and scientific associations. The programe covers the entire field of hydrology from collection of standard basic data to advanced basic research. (Knapp-USGS)
W70-03450

ARROGANCE TOWARD THE LANDSCAPE: A PROBLEM IN WATER PLANNING,
Geological Survey, Washington, D.C. Water Resources Div.
Raymond L. Nace.
Bulletin of the Atomic Scientists, Vol 25, No 10, p 11-14, Dec 1969. 4 p, 2 photo.

Descriptors: *Water resources development, *Planning, *Projects, *Surveys, *Reviews, Ecology, Urbanization, Land management, History.
Identifiers: Water development history.

The effects of water resources development on water supplies and the environment are surveyed. Water is much more than just a resource to be manipulated on the basis of water data and engineering works. In a society, demands and values change, so no final solution for water problems will be found at any time, and planning must be a continuing process. Rational planning and decision require a base of pooled knowledge from geologists, hydrologists, ecologists, engineers, economists, sociologists, managers, lawyers, politicians and others. Water and its movement through the hydrological cycle are essential means for maintaining the heat balance in the complex system of the earth and its inhabitants. Water is the prime agent that shapes or misshapes the landscape, according to what kind of landscape it encounters. Men have much to do with the latter. Is it mere coincidence that Persia, Egypt, West Pakistan, India, and China--all 'underdeveloped' areas today--were the seats of the oldest civilizations. Perhaps it is an inherent characteristic of civilization that it wears out its landscapes. Human occupation, at least during the past 2,000 years, has operated chiefly to harm the landscape, not to preserve it. Ability to plan and create monumental projects carries with it the likelihood of making monumental mistakes. Planning must include careful analysis of the possible results of any water development schemes. (Knapp-USGS)
W70-03465

PRESIDENT'S LECTURE: LIMNOLOGY, SOCIAL WELFARE, AND LAKE KINNERET,
Uppsala Univ. (Sweden). Inst. of Limnology.
For primary bibliographic entry see Field 02H.
W70-03509

07. RESOURCES DATA

7A. Network Design

THEORETICAL FOUNDATION OF HYDROMETRY (RUSSIAN),
G. V. Zheleznyakov.
Leningrad, Gidrometeorologicheskoye Izdatel'stvo, 1968. 291 p, 104 fig, 41 tab, 103 ref.

Descriptors: *Water measurement, *Instrumentation, *Hydrometry, Streamflow, Water levels, Velocity, Turbulent flow, Gages, Hydrometers, Current meters, Weirs, Runoff, Discharge (Water), Hydraulics, Flood plains.
Identifiers: *USSR.

The theoretical aspects of hydrometry are discussed and the procedures used in carrying out hydrological observations in rivers and river channels are given. Hydromechanical analyses of instruments for measuring current velocities are also given. The discussion includes: open water surface relief and depth of nonuniform flow; velocity distribution in open turbulent flows; bottom velocities of open streamflows; use of hydrometric devices in open streamflow; hydromechanical analysis of current meters; foundation of the procedures for measuring small velocity streamflows; hydrometric weirs; shape parameters of open-streamflow cross sections; hydraulic and hydrometric methods for the determination of discharges in open river channels; interaction between the flood plain and channel streamflows; and hydraulic basis of the dependence of water levels on streamflow discharges. (Gabriel-USGS)
W70-03474

THE EFFECTIVENESS OF COLLECTING HYDROLOGIC DATA AT MAYNARD CREEK WATERSHED VIA A DATA ACQUISITION SYSTEM,
Montana State Univ., Bozeman. Water Resources Research Center.
Theodore T. Williams, and Duain Bowles.
Available from the Clearinghouse as PB-189 407, $3.00 in paper copy, $0.65 in microfiche. Montana University Joint Water Resources Research Center, Report No 11, Sept 1968. 40 p, 3 tab, 3 fig, 1 ref, 2 append. OWRR Project A-006-MONT.

Descriptors: *Data collections, *Data transmission, *Hydrologic data.
Identifiers: *Collecting hydrologic data, *Acquisition system, *Digital signals, Teletype machines, Electronic instruments.

Three recording rain gages, three recording hygothermographys and three Parshall flumes equipped with water level recorders were installed on the Maynard Creek watershed. The instruments were modified to permit the simultaneous tranmission of data over the Bridger Data Acquisition System to the Montana State University campus. Conclusions are that a Data Acquisition System provides many advantages to a hydrologic researcher, but that certain recommendations should be considered: (1) Avoid 'piggy-back' parallel operation of electronic instruments through modification of conventional instruments. (2) Convert analog to digital signals at the instrument, and transmit only digital signals via telemetry. (3) Avoid long 'ground surface' cabling networks. (4) Review data promptly and regularly to spot any malfunction that may arise.
W70-03615

7B. Data Acquisition

A NEW RECORDING TURBIDITY METER FOR RIVERS,
Natal Univ., Durban (South Africa).
W. James.
Bulletin of the International Association of Scientific Hydrology, Vol 14, No 4, p 71-76, Dec 1969. 6 p, 6 fig, 1 ref.

Descriptors: *Turbidity, *Instrumentation, *Sampling, Opacity, Light penetration, Optical properties, Suspended load, Rivers, Water quality.
Identifiers: *Natal, Turbidity meters.

An inexpensive continuously recording turbidity transducer on two different types of mounting has been developed at the University of Natal, and installed at two stations in the Umegeni River system. The geometry and components of the transducers are detailed, and a sampler used to calibrate the transducers is also described. A portable turbidity meter has also been developed. (Knapp-USGS)
W70-03277

AN OPTICAL METHOD OF MEASURING GRAIN ORIENTATION IN SEDIMENTS,
Koninklijke-Shell Exploratie en Produktie Laboratorium, Rijswijk (Netherlands).
For primary bibliographic entry see Field 02J.
W70-03282

X-RAY RADIOGRAPHY FOR EXAMINATION OF BURROWING IN SEDIMENTS BY MARINE INVERTEBRATE ORGANISMS,
Georgia Univ., Sapelo Island. Marine Inst.
For primary bibliographic entry see Field 02J.
W70-03286

PARTICLE SHAPE AND INFERENCE OF SIZE FROM SIEVING,
Gulf Research and Development Co., Pittsburgh, Pa.
For primary bibliographic entry see Field 02J.
W70-03287

ECOLOGICAL TECHNIQUES UTILIZING RADIONUCLIDES AND IONIZING RADIATION - A SELECTED BIBLIOGRAPHY,
Washington State Univ., Pullman. Dept. of Zoology.
Vincent Schultz.
US Atomic Energy Commission, Division of Technical Information, RLO-2213-1, Dec 1969. 252 p, 3081 ref.

Descriptors: *Bibliographies, *Radioecology, *Radioisotopes, *Radioactivity, *Radiation, Aquatic environments, Terrestrial habitats, Analytical techniques, Environmental effects, Tracers, Pesticides.
Identifiers: *Ecological techniques, Data acquisition, Freshwater environments, Marine environments.

Environmental deterioration has increased public awareness of the ecologist's role in predicting and alleviating the effects of cultural misuse of the environment. Complexities of the problems, now and in the future, require that ecologists develop and utilize the most advanced techniques possible to elucidate information which can be used for intelligent and effective decisions regarding environmental management. This bibliography of 3081 entries attempts to focus the attention of all ecologists on techniques utilizing radionuclides and ionizing radiation developed by freshwater, marine, and terrestrial ecologists, as well as by scientists in closely related fields. Of all references cited, with publication dates between 1922 and 1969, approximately 87% are dated in the decade beginning 1960. The most recent literature and Russian contributions are well represented in the list. (Eichhorn-Wisconsin)
W70-03308

NONDESTRUCTIVE TESTING,
Machine Design, Cleveland, Ohio.
Francis J. Lavoie.
Mach Des, Vol 41, No 20, p 122-135, Sept 1969. 14 p, 19 fig

Descriptors: *Non-destructive tests, *Materials testing, *Test procedures, Radiographic inspection, Quality control, Inspection, Materials engineering, X-ray inspection, Gamma rays, Neutrons, Fluoroscopes, Ultrasonics, Thermographs, Penetration, Microwaves, Acoustic equipment, Measuring instruments.
Identifiers: *Testing equipment, Radiography, Ultrasonic tests, Eddy currents, Stress waves, Holography, Acoustic method.

This review of nondestructive test methods ranges from the established and widely known methods to the newest and most glamorous, and includes flaw or defect-finding techniques. The methods described are: radiography, ultrasonics, thermal techniques, penetrants, magnetic inspection, microwaves, eddy current, acoustic emission, and holography. Radiographic methods include X-ray, gamma ray, neutron, radiation backscatter, fluoroscopy, color radiographs, and xeroradiography. Holography, one of the most glamorous developments in recent years, is well suited for flaw detection. (USBR)
W70-03356

A RAINFALL RATE SENSOR,
Coast and Geodetic Survey, Rockville, Md.
Brian E. Morgan.
ESSA Tech Memo ERLTM-NSSL 42, Nat Severe Storms Lab, Norman, Okla, Nov 1968. 10 p, 7 fig, 2 ref.

Descriptors: *Rainfall, *Rain gages, *Meteorological instruments, *Hydrologic instruments, Rain, Measuring instruments, Instrumentation, Meteorology, Hydrology, Thunderstorms, Meteorological radar, Sensors, Oscillators, Capacitance, Electrodes.
Identifiers: Hydrometeorology.

A rainfall rate measuring instrument that has a range of 250 mm/hr, an accuracy of plus or minus 2 mm/hr, and gives total rainfall within 2% was developed. The gage is inexpensive to build and operate, and does not require daily attention because water does not accumulate. Rainwater passes from a collector into a cylindrical reservoir formed between 2 concentric electrodes. Water empties from the reservoir through a small nozzle at the base. Water depth in the reservoir is related to the inflow or rainfall rate that varies the capacitance between the 2 electrodes. The rainfall rate is measured by an oscillator having the electrodes as capacitance elements that translate depth changes into frequency variations. Equations are developed for relating rainfall rate to frequency, with emphasis on relevance to design of the instrument for specific applications. Laboratory test results and rainfall measurements are discussed. (USBR)
W70-03363

A NON-DESTRUCTIVE CORE ANALYSIS TECHNIQUE USING X-RAYS,
Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Geology.
Seymour R. Baker, and Gerald M. Friedman.
Journal of Sedimentary Petrology, Vol 39, No 4, p 1371-1383, Dec 1969. 13 p, 18 fig, 4 ref. ONR Contract No N000 1467-A-0117-0004.

Descriptors: *X-ray analysis, *Analytical techniques, *Sediments, *Cores, Stratigraphy, Structural geology, Sampling, Instrumentation, Particle size, Carbonates, Photography.
Identifiers: X-ray core analysis technique.

An X-ray technique which permits the identification of sedimentological, stratigraphic, and structural characteristics of core samples is described. This technique utilizes an aluminum filter which compensates for the difference in sediment thickness through which the X-ray penetrates. This quick, easy, and inexpensive method provides a complete picture log of the core. (Gabriel-USGS)
W70-03470

7C. Evaluation, Processing and Publication

THE WATER RESOURCES SITUATION IN PUERTO RICO: AN EVALUATION OF PUBLISHED INFORMATION,
Puerto Rico Univ., Mayaguez. School of Engineering.
For primary bibliographic entry see Field 06B.
W70-03245

COHERENCE ANALYSIS OF STATIONARY PROCESSES WITH APPLICATIONS TO HYDROLOGY,
Colorado State Univ., Fort Collins.

Ignacio Rodriguez-Iturbe, and M. M. Siddiqui.
Bulletin of the International Association of Scientific Hydrology, Vol 14, No 4, p 77-94, Dec 1969. 18 p, 5 fig, 18 ref.

Descriptors: *Statistical methods, *Frequency analysis, *Time series analysis, Stochastic processes, Uniformity coefficient, Regression analysis, Probability, Hydrology, Rainfall-runoff relationships, Streamflow forecasting.
Identifiers: Spectral analysis, Coherence analysis, Cross-spectral analysis.

Cross-spectral characteristics of the moving average and autoregressive processes are shown to be a powerful tool in testing and analyzing processes in hydrology. The coherence between two 1st order autoregressive processes is shown to be equal to a constant, independent of frequency. (Knapp-USGS)
W70-03256

REDUCTION OF SERIALLY CORRELATED HYDROLOGIC DATA,
Pittsburgh Univ., Pa. Dept. of Civil Engineering.
Rafael G. Quimpo.
Bulletin of the International Association of Scientific Hydrology, Vol 14, No 4, p 111-118, Dec 1969. 8 p, 1 fig, 10 ref.

Descriptors: *Statistical methods, *Data processing, *Hydrologic data, *Streamflow, *Correlation analysis, Sampling, Parametric hydrology, Data collections, Water supply, Regression analysis, Storage, Digital computers.
Identifiers: Serial correlation.

The need for specifying water availability in terms of its time sequence and distribution, rather than in terms of lumped quantities or flow duration, gives rise to data acquisition programs which use shorter sampling intervals. Shorter time intervals, in turn, resulted in serially correlated observations. In order to determine the reliability of design variables derived from these observations, it is necessary to reduce data to an equivalent series of independent observations, or find the effective length of the series. A general parametric formula is developed to give the effective number of observations of the second order autoregressive process, which was found to apply to series of mean daily river flows. Different values of the parameters were programmed in a digital computer to obtain tables for data reduction. (Knapp-USGS)
W70-03263

THE CHEMICAL AND PHYSICAL PARAMETERS IN A HYDROLOGIC TRANSPORT MODEL FOR RADIOACTIVE AEROSOLS,
Stanford Univ., Calif. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-03296

SIMILITUDE FOR FLOW OF TWO FLUIDS IN POROUS MEDIA,
Shell Oil Co., Denver, Colo. Rocky Mountain Div.; and Colorado State Univ., Fort Collins. Dept. of Agricultural and Irrigation Engineering.
For primary bibliographic entry see Field 02F.
W70-03297

VARIATIONS IN STATISTICAL MEASURES WITH THE LENGTH OF STREAMFLOW RECORDS,
Waterloo Univ (Ontario).
B. P. Sangal, T. E. Unny, and H. M. Hill.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 41, p 314-321, 1967. 8 p, 2 fig, 4 tab.

Descriptors: *Streamflow forecasting, *Statistical methods, Climatology, Regression analysis, Data processing, Digital computers, Computer programs, Hydrologic data.
Identifiers: Streamflow record length.

Hydrologic data are necessary in the planning and development of a water resource project. More and better data result in better project decisions. Unfortunately, often important decisions have to be made in spite of hydrologic deficiences. This paper describes a statistical analysis of long (48 years) flow records of five streams in Southern Ontario (Canada). The computations are carried out at the University of Waterloo IBM 7040 computer. Records of 20-25 years are considered adequate for the estimation of mean annual runoff. The results are considered acceptable within 10-15 percent of their long-term values. (Knapp-USGS)
W70-03303

BUILDING A COMPUTER-BASED MIS,
Terminal and Display Systems, Inc.
For primary bibliographic entry see Field 10.
W70-03360

CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO WATER QUALITY STATIONS,
Geological Survey, Washington, D.C. Office of Water Data Coordination.
K. F. Harris, J. R. Rapp, and E. B. Chase.
Available at no cost from Office of Water Data Coordination, US Geol Survey, Wash, DC, 20242. Geological Survey Water Data Catalog, 1969. 391 p, 2 fig, 2 exhibit, 4 tab.

Descriptors: *Data collections, *Hydrologic data, *Water quality, *Documentation, *Data storage and retrieval, Networks, Monitoring, Sampling, Maps, Instrumentation, .Stations, Libraries, Investigations.
Identifiers: *Catalog of Information on Water Data.

An index is presented for use in retrieving water quality data from the Catalog of Information on Water Data, a record of activities in water data collection in the U. S. The Catalog is a file of information that is accessible through data-retrieval procedures--it contains information about water-data acquisition activities but does not contain the actual data, which must be obtained from the reporting agencies. Input to the Catalog consists of information supplied by Federal, State, and local agencies that acquire water data directly in the field and laboratory. All information is stored on media suitable for data processing, supplemented by microforms and maps. Information from the Catalog (output) is made available through indexes such as this publication, which is the index to the water quality section of the Catalog. The indexes help the water-data user determine the data that are available for an area and also the data available from a reporting agency. The index includes the title of each investigation reported, the geographic area covered, a description of types of data collected, whether or not a report will be published, and the reporting agency. (Knapp-USGS)
W70-03473

CATALOG OF TSUNAMIS IN THE HAWAIIAN ISLANDS,
Coast and Geodetic Survey, Rockville, Md.
For primary bibliographic entry see Field 02L.
W70-03476

SIMULATION OF RUNOFF FOR DESIGN OF WATER RESOURCE SYSTEMS,
State Water Plan Development of Water Resources Management, Prague (Czechoslovakia).
For primary bibliographic entry see Field 02A.
W70-03496

THE EFFECTIVENESS OF COLLECTING HYDROLOGIC DATA AT MAYNARD CREEK WATERSHED VIA A DATA ACQUISITION SYSTEM,
Montana State Univ., Bozeman. Water Resources Research Center.
For primary bibliographic entry see Field 07A.
W70-03615

08. ENGINEERING WORKS

8B. Hydraulics

UNIVERSAL FORMULA FOR UNIFORM FLOW,
Tennessee Valley Authority, Norris. Engineering Lab.
Walter O. Wunderlich.
Civil Engineering - ASCE, Vol 40, No 1, p 51-52, Jan 1970. 2 p, 8 ref.

Descriptors: *Open channel flow, *Equations, Chezy equation, Mannings equation, Reynolds number, Roughness (Hydraulic), Turbulent flow, Steady flow, Uniform flow, Mathematical studies.
Identifiers: Blasius equation.

Formulas for computing uniform open channel flow are briefly reviewed. The discussion includes Chezy's formula, modified Chezy's formula, Manning's formula, Blasius' formula, and formulas for turbulent flow along rough walls. (Knapp-USGS)
W70-03248

THEORETICAL FOUNDATION OF HYDROMETRY (RUSSIAN),
For primary bibliographic entry see Field 07A.
W70-03474

STREAMFLOW EFFECTS IN A STRATIFIED MODEL RESERVOIR,
Oregon State Univ., Corvallis.
E. Harvey Elwin, and Larry S. Slotta.
ASCE National Water Resources Engineering Meeting, Jan 26-30, 1970. Preprint, 38 p, 30 ref, 17 fig.

Descriptors: *Model studies, *Stratification, *Quality control, *Density currents, Streamflow.

This study relates various parameters of entering streamflow at the upper end of a stratified reservoir to the current regime in the reservoir for the purpose of maintaining quality control. The model reservoir for the inflow experiments was a clear walled, rectangular, plexiglas flume. It was equipped with an adjustable bottom slope and a connecting streambed slope. The reservoir was 25 feet long, 18 inches wide, and 22 inches deep. Various concentrations of a sodium chloride solution were used to provide a linear density stratification. Flowfield current patterns and velocity measurements were determined photographically. Flow parameters relating the existence, location and magnitude of model internal density currents to entering streamflow characteristics were found. The applicability of these model reservoir results to prototype reservoir conditions is discussed. Some conclusions were: (a) For the range of values tested the entering model streamflow created two possible main inflow density currents in the model reservoir. (b) The upper inflow current increased its magnitude as the model streamflow Reynolds number increased. (c) The elevation of the upper inflow current was independent of the velocity and density of the inflow. The evaluation of the lower inflow current was dependent on the density of the inflow and the mixing which occured at the stream mouth. (d) The interaction between two reservoir density currents created a significant reinforcement of both currents. (Guerrero-Vanderbilt)
W70-03543

MECHANICS OF STRATIFIED FLOW THROUGH ORIFICES,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
Joseph R. Bohan, and John L. Grace.
ASCE National Water Resources Engineering Meeting, Memphis, Tenn, Jan 26-30, 1970. Preprint, 33 p, 22 ref, 12 fig.

Descriptors: *Stratified flow, *Orifices, *Model studies.

Identifiers: *Velocity distribution, *Water intakes.

The purpose was to determine the characteristics of the withdrawal zone upstream of an orifice for various conditions of stratification in order to develop generalized equations for use in predicting the quality of water discharged through similar openings in prototype intake structures. The experimental facilities contained an orifice cut in a piece of plastic and located in the center of a 1-ft. wide channel. Approximately 18 ft. of the 1-ft. wide, 2-ft. deep channel was provided upstream of the orifice and a headbay 40 feet long, 16 feet wide, and 4 feet deep was provided upstream of the channel. Stratification was generated using dissolved solids (salt). Temperature and salinity gradients were measured in place by means of commerically available instrumentation. All the tests were conducted with steady uniform flow conditions. Some conclusions were: (a) A means of predicting the limits of and the velocity distribution within the zone of withdrawal upstream of an orifice has been developed. (b) Three dimensional models operated in such a manner that they reproduce typical hydrograph records should be utilized to investigate the effects of unsteady and varied flow conditions due to variations in geometry, inflow, outflows, storage and density. (c) Additional studies are desired to investigate model scale effects and the relative importance of viscous effects. (d) The effect of geometry in the vicinity of an intake structure has been observed to be significant based on the results of specific model studies. (Guerrero-Vanderbilt)
W70-03544

ENTRAINMENT PRINCIPLE AND ITS RESTRICTIONS TO SOLVE PROBLEMS OF JETS,
Waterloopkundig Laboratorium, Delft (Netherlands).
G. Abraham.
Journal of Hydraulic Research, Vol 3, No 2, p 1-23, 1965. 6 fig, 1 tab, 18 ref.

Descriptors: *Jets, *Buoyancy, *Turbulent flow.
Identifiers: *Entrainment.

Studies were made of the theories for solution of jet problems based on both the entrainment principle and the similarity of velocity and concentration profiles. Jets with negligible and with predominant influence of buoyancy effects are described. The implications of the contradictory starting points which are based on both the entrainment principle and the similarity of velocity and concentration profiles are explained, and a new coefficient is introduced. This parameter, E', is a dimensionless representation for the rate at which work is done by turbulent shear. Conclusions were: (a) the similarity of velocity and concentration profiles is shown to imply that the entrainment coefficient alpha is a variable quantity. Accordingly, theoretical solutions based on both the similarity of velocity and concentration profiles and on the entrainment principle, which implies alpha to be constant, are based on contradictory starting points, (b) theoretical solutions based on the assumption of alpha being constant may give incorrect values of the ratio of the radius of the jet to the distance from the orifice, (c) the similarity of velocity and concentration profiles was shown to be compatible with the assumption of the parameter E' being constant. (Guerrero-Vanderbilt)
W70-03545

DISCUSSION OF 'TURBULENT MIXING PHENOMENA OF OCEAN OUTFALLS' BY R. FRANKEL AND J. CUMMING,
California Inst. of Tech., Pasadena, Calif. W. M. Keck Lab. of Hydraulics and Water Resources.
Loh-Nien Fan, and Norman H. Brooks.
Journal of the Sanitary Engineering Division, Proceedings of ASCE, Vol 92, No SA1, p 296-300, Feb 1966.

Descriptors: *Mixing, *Stratification, Froude number.
Identifiers: *Buoyant plume, Model.

Research performed by Frankel and Cumming provided greater insight into the problem of mixing of a buoyant plume in a homogeneous environment such as jet discharges of sewage effluent from ports in an ocean outfall diffuser, when the ocean is not density-stratified. The effect of the free surface is discussed, and it is concluded that the wide discrepancy between Frankel and Abraham's theory is not explained by the effect of the surface zone and that the thickness of the transition zone should be considered not only as a simple proportion of the depth but also as a function of the parameters of the rising plume, depth-diameter ratio, Froude number and the discharge angle. Furthermore, the thickness should also be related to the character of the horizontal surface flow layer as well as the rising plume. In performing experiments in the laboratory, it was found more convenient to inject salt solutions into fresh water and observe the pattern of the falling plume. In the discussion of the asymptotic rate of change of measured concentration with depth, a contradiction was found to the author's conclusion that for large depth-diameter ratio, the exponent in the equation approaches one. The conclusion that 'further increases in depth beyond depth-diameter ratio equal 50 give minimal advantages to mixing in the vicinity of the discharge point', is disputed and an example is given. (Guerrero-Vanderbilt)
W70-03553

JET DIFFUSION, REVIEW OF MODEL TESTING AND COMPARISON WITH THEORY,
Chalmers Univ. of Technology, Goteborg (Sweden). Hydraulics Div.
Klas Cederwall.
Chalmers Institute of Technology, Goteborg, Sweden, Feb 1967. 28 p, 17 ref.

Descriptors: *Jets, *Diffusion, *Testing, *Model studies, *Outlets, *Sewers.

The significance of laboratory investigations in solving various jet diffusion phenomena is discussed. Pertinent parameters such as the density and composition of the disposed effluent, hydraulic characteristics of sewage discharge, and oceanographic features of the disposal site area and boundary conditions are analyzed. The possibilities of reproducing field data in model tests, model laws on jet diffusion, tracer technique, sampling and recording devices are discussed. The study on jet diffusion in stagnant receiving water carried out by Abraham serves as a basis for discussion of the experimental studies on jet diffusion and a comparison with theory in the cases of vertical jet diffusion, horizontal jet diffusion and high velocity release. In most cases, a fair agreement was found between the analytical procedure and experimental data. (Guerrero-Vanderbilt)
W70-03555

DISCUSSION OF 'HORIZONTAL JETS IN STAGNANT FLUID OF OTHER DENSITY' BY G. ABRAHAM,
California Inst. of Tech., Pasadena. W. M. Keck Lab. of Hydraulics and Water Resources.
Loh-Nien Fan, and Norman H. Brooks.
Journal of the Hydraulics Division, Proceeding ASCE, Vol 92, HY2, p 423-429, Mar 1966.

Descriptors: *Jets, *Stratification, Turbulent flow.
Identifiers: *Entrainment rate.

Abraham's representation of the entrainment rate in the jet is discussed, and it is mentioned that one of the main difficulties in analysis of turbulent jets is to specify the rate at which fluid is entrained in the jet or alternatively to specify the rate of growth of the plume or jet. The writers suggest an alternative to the author's representation of the entrainment rate, assuming that the rate of entrainment is proportional to the local characteristic (or maximum) velocity, um, and the local characteristic radius of the jet or plume, following the techniques used by Morton, Taylor, and Turner, and Morton. By this means, full use is made of the continuity equation. An analysis of how the problem solved by Abraham can also be readily solved using the continuity equation with constant entrainment coefficient is made. The results agree with Abraham's and thus suggest that the simple entrainment formula is as valid as the author's approach, with the advantage that is more flexible and can be used on a wider variety of problems, such as those involving buoyant jets and plumes in a stratified environment. (Guerrero-Vanderbilt)
W70-03560

STATISTICAL PROPERTIES OF BED FORMS IN ALLUVIAL CHANNELS IN RELATION TO FLOW RESISTANCE,
Iowa Univ., Iowa City. Dept. of Mechanics and Hydraulics.
Venkata Subramanya Shastri Annambhotla.
Ph. D. Thesis, University of Iowa, Aug 1969. 137 p, 9 tab, 27 fig, 50 ref. OWRR Project A-015-IA (5).

Descriptors: *Alluvial channels, Channel morphology, *Roughness (Hydraulic), *River beds, *Flow resistance, Fluid friction, Flumes, Hydraulic design.
Identifiers: *Bed forms (River), Hydraulic friction factor.

The statistical properties of dune bed forms in alluvial channels was investigated and related to the hydraulic friction factor. Emphasis was placed on the relationship between resistance to flow and bed configuration in large rivers. Bed profile records were acquired from a straight 3-feet wide laboratory flume and from the Missouri River at Omaha, Nebraska. Discrete digital data of the fine sand bed profiles were obtained from continuous records and statistical computations were performed. The river data were nonstationary both in the mean and in the mean square. A filter was selected to render the data stationary in the mean. Pilot studies, made by analyzing selected river data by spectral analysis and zero-crossing distances and amplitudes analysis, suggested that the latter of the two methods is preferable. Statistical properties of the wave lengths, amplitudes and heights were evaluated by the zero-crossing distances and amplitudes analysis for selected flume data and all river data. A study of the frequency distributions of the bed form characteristics showed that the bed elevations were approximately normally distributed and that the wave lengths, amplitudes and heights were approximately exponentially distributed. The bed form friction factor was plotted against a modified relative roughness parameter defined in terms of the bed form dimensions and the hydraulic mean radius of the flow. A more definitive resistance relationship could not be formulated, however, because of the limited number of observations and also because of inadequate information on the suspected effects of the variations in the shape and arrangement of dune forms. Effects of water temperature on bed form roughness were observed to be significant. The tendency in the Missouri River was that the bed forms became rougher with increasing temperatures and vice versa. Reasonably good measures of bed form characteristics can be obtained by statistical analyses.
W70-03620

8C. Hydraulic Machinery

FLOW BETWEEN A RESERVOIR AND A HEADPOND,
Spiridon Iliev.
Water Power, Vol 21, No 9, p 331-335, Sept 1969. 5 p, 3 fig, 1 tab, 3 ref.

Descriptors: *Electric power production, *Forebays, Hydraulic engineering, Piping systems (Mechanical), Hydraulic properties, Pressure tunnels, Hydraulic design, Equations, Hydraulics, Continuity equation, Pressure pipes, Foreign research, Hydroelectric plants, Reservoirs, Hydroelectric power.
Identifiers: Design assumptions, Comparative studies, Bernoulli theorem, USSR.

Some costs of a hydroelectric system involving a reservoir remote from the power station may be saved by constructing a headpond near the station, thereby reducing the required diameter of the supply tunnel or pipeline. Using a headpond permits a reduction in installed capacity of the powerplant and makes possible a larger output because the local storage can be used with smaller losses and the limiting condition for critical velocity in the connecting supply tunnel or pipeline can be avoided. Equations are derived for solving the hydraulics of a supply system containing a headpond; a sample problem is presented. (USBR)
W70-03355

ENERGY REQUIREMENT AND ITS ROLE IN THE PAST, PRESENT, AND FUTURE DEVELOPMENT OF GRAND COULEE DAM,
Bureau of Reclamation, Boise, Idaho.
G. R. Barker.
Pap, 83rd Annu Gen Meet Eng Inst Can, Vanouver, Sept 1969. 13 p.

Descriptors: *Grand Coulee Dam, *Electric power production, *Peak power, Project planning, Irrigation, History, Multiple-purpose projects, Electric power, Investigations, Peaking capacities, Automation, Energy, Pumping plants, Pump turbines, Stators, Flood control, Hydroelectric plants, Columbia River, Hydroelectric power.
Identifiers: Grand Coulee Powerplant (Wash), Grand Coulee Pumping Plt (Wash), Pacific Northwest-Southwest Intertie, Base loads.

Factors affecting the development of Grand Coulee Dam from inception as a key structure for an irrigation project, through present-day multi-purpose operation, and into the future on a coordinated power peaking and irrigation pumping schedule are described. The history of the Grand Coulee Dam from 1918, with Rufus Wood's first published story of a proposed high dam on the Columbia River to the present-day 1974 mw of generating capacity and 6 pumping units capable of irrigating 600,000 acres of land, is reviewed. A program of rewinding existing 108-mw generators to produce 125 mw is scheduled for completion by 1977. Modernization features being initiated for automating the plant are discussed. Future installations call for a Third Powerplant of 12 units, 600 mw each, and 6 additional pump-turbine units in the pumping plant, bringing the ultimate capacity of the Grand Coulee Dam to 9771 mw, the largest single electric power generating station in the world. (USBR)
W70-03358

THE ELECTROCHEMICAL METHODS OF PROTECTING HYDROTURBINES AGAINST CAVITATION EROSION,
N. I. Pylaev, and A. A. Sotnikov.
Energomashinostr, Vol 14, No 2, p 26-28, 1968. Transl from Russ, Bur Reclam Transl 823, Oct 1969. 9 p, 5 fig, 3 ref.

Descriptors: *Cathodic protection, *Hydraulic turbines, *Cavitation, Laboratory tests, Electric fields, Corrosion, Anodes, Corrosion control, Cathodes, Foreign research, Electric potential, Conductivity, Protective coatings, Electrodes.
Identifiers: USSR, Current density, Test results, Cavitation control.

The electrochemical method of protection from cavitation erosion has been applied experimentally on turbines of a few hydroelectric powerplants. The method consists of the simultaneous use of protective zinc paint and cathodic protection from an external source. Under turbine operating conditions, evaluating the effectiveness of electrochemical protection is difficult. Laboratory experiments were conducted to study the effectiveness of cathodic protection; results are reported. From a study of the electric field in a model turbine, calculations were made of the cathodic protection parameters for the Krasnoiarsk turbines, indicating that no less than 400 v would be required. Such voltage cannot be considered permissible from a safety engineering standpoint. Efficient cathodic protection on large hydraulic turbines operating in water with high specific resistance becomes practically impossible. (USBR)
W70-03366

ASSESSING OUTDOOR INSULATION,
Centro Elettrotecnico Sperimentale Italiano, Milan.
P. Bernadelli.
Energy Int, Vol 6, No 8, p 20-24, Aug 1969. 5 p, 4 fig, 2 tab, 16 ref.

Descriptors: *Contamination, *Electrical insulators, Atmospheric pollution, *Electric insulation, *Laboratory tests, Test procedures, Lightning, Dusts, Salts, Foreign research, Test facilities, Air pollution, Air pollution effects, Bibliographies.
Identifiers: *Contaminants, *Leakage current, *Flashover, Italy, Switching surges, Lightning surges, Reproducibility, Electric discharges.

The problem of external electric insulation in contaminated areas is becoming increasingly important because of growing industrialization in continental areas and the location along sea coasts of large thermal powerplants with their associated substations and high voltage lines. In such particularly contaminated areas, pollution produces an insulation stress almost as important as that caused by lightning and switching overvoltages. Two laboratory testing methods, the salt fog method developed in England and the dust deposit method developed in Germany, are discussed and a cost comparison between the 2 types of installations is given. A general review of the present state of investigations on the behavior of external electrical insulation in contaminated atmosphere is given, with particular reference to a-c voltage stress. Available knowledge permits an engineering approach to insulation design problems. After sufficient experience, some laboratory testing method should become standarized by international bodies. (USBR)
W70-03368

EXPERIMENTAL HORIZONTAL BULB TURBINES FOR SARATOV HYDROPOWERPLANT,
M. L. Steklov.
Energomashinostr, No 5, p 6-10, 1969. Transl from Russ, Bur Reclam Transl 822, Oct 1969. 16 p, 3 fig, 5 ref, append.

Descriptors: *Hydraulic machinery, Kaplan turbines, Turbine runners, *Hydraulic turbines, Stay rings, Stay vanes, *Turbine parts, *Bearings, Draft tubes, *Bulb turbines, Prototype tests, Field tests, Generators, Oil reservoirs, Bearing capacities, Hydraulic design, Water cooling, Foreign research, Servomechanisms.
Identifiers: USSR, Experimental design, Saratov Powerplant (USSR), *Pressure control mechanism.

Two experimental Kaplan bulb turbines having the same dimensions but slightly different design will be installed at Saratov Hydropowerplant for field testing. The main difference in design is the method of supporting the units: The first has 2 bearings and inlet and outlet stay rings; the second, without the outlet ring, has an extra turbine bearing and cantilever support of the runner. Advantages of the second design are improved power characteristics and a reduction of more than 10% in weight, but the satisfactory support of the turbine without the outlet stay ring under all operating conditions must be demonstrated. All preliminary bearing tests indicate that the bearings with 2 fixed upper shoes and 8 self-leveling lower shoes will take double the normal operating load, but the Soviet turbine designers feel that this side-by-side prototype testing is necessary because of the increased size of these units in physical dimensions and capacity as compared to any operating units of the world. A new design of combined oil and water head in the bulb nose, reducing the overall space of this equipment, supplies the oil to the servomotors from the electrohydraulic governor system and the water to cool the generator rotor. (USBR)
W70-03369

HYDRAULIC CONTROLS OF WATER LEVEL,
E. E. Makovskii.
Gidrotekh i Melior, No 8, p 35-42, 1968. Transl from Russ, Bur Reclam Transl 688, Aug 1969. 18 p, 8 fig, 3 ref.

Descriptors: *Irrigation canals, Irrigation practices, Hydrodynamics, Irrigation systems, Automation, *Automatic control, Check structures, Foreign design practices, Irrigation operation and maintenance, Water measurement, Water surface profiles, Turnout gates, Remote control, Gates, Instrumentation, Mechanical equipment, *Water levels.
Identifiers: USSR, Water distribution.

Automatic remote control of water levels in all checks and drops in an irrigation system (cascade controls) has been developed and tested successfully in the USSR in the Atbashinsk Main Canal in Kirgiz SSR since 1963. Standard designs for cascade controls with downstream protection against overfilling are being perfected and tested for general use in the Northern Crimean Canal in the Ukraine. The mechanics and operating principles of several alternative designs of cascade control systems are investigated. Mathematics for designing such systems and graphs for determining the various gate parameters, such as vertical contraction of flow and depth of submergence, are given. This system of hydraulic controls probably gives more reliable and flexible water-level control with settings within wider limits than well-known foreign designs, especially where there are floating materials in the canal or significant drops in water level or rapid flow downstream. (USBR)
W70-03373

MHD POWER GENERATION: CURRENT STATUS,
Tennessee Univ., Tullahoma. Space Inst.; and Westinghouse Electric Corp., Pittsburgh, Pa. Research and Development Center.
J. B. Dicks, Stewart Way, and T. R. Brogan.
Mech Eng, Vol 91, No 8, p 18-25, Aug 1969. 8 p, 7 fig, 53 ref.

Descriptors: *Magnetohydrodynamics, Electric power, *Electric power production, *Magnetic fields, *Gases, Reviews, Experimental data, Ions, Bibliographies, Electrodes, Electric fields, Seeding, Efficiencies, Research and development, Economics, Excitation, High pressure.
Identifiers: Gas conductors, Fossil fuels, High temperature, Superconductors.

In magnetohydrodynamic (MHD) generation, a gas moves through a magnetic field to produce an electric current. The internal energy of the gas stream is converted directly to electric energy that is drawn off through electrodes replacing the brushes of conventional generators. The status of MHD generation is discussed and experimental MHD units ranging from 3 to 32 mw are reviewed. Three approaches to MHD power are explored, the open-cycle system, the closed-cycle system, and the liquid metal system. Of these 3 types, the open-cycle system is closest to practical realization. This report concentrates principally on the attainments, problems, and outlook for open-cycle MHD powerplants for commercial applications. (USBR)
W70-03374

MULTIPLE USE OF RIGHTS OF WAY: A CHALLENGE TO THE PAST,
Federal Power Commission, Washington, D.C.
Carl E. Bagge.
Pap, Conf Joint Util Rights Way, Deerfield, Mass, July 1969. 14 p.

Descriptors: *Right-of-way, Environment, Aesthetics, Project planning, *Multiple use, Planning, *Public utilities, Public relations, Ecology, *Public services, Legislation, Legal aspects, *Utilities, *Future planning (Projected).

Identifiers: *Land acquisition, Electric utilities, Regional planning, Regional authorities.

Joint rights of way for highways, energy transmission, and communications at appropriate distances from each other should be considered simultaneously with the development of comprehensive regional plans. The central theme of effective regional planning is the early acquisition of land for such public service rights of way. This is a matter of urgency in congested areas and a means of preventing serious problems in less populated areas. The form of acquisition could be determined easily once the philosophical commitment is made. Many public service companies share rights of way, and recently joint use has been emphasized by government, industry, and citizens groups as a promising means of minimizing the intrusion of utility rights of way on the quality of our environment. Examples are cited of low-voltage powerlines and telecommunications lines sharing rights of way with each other, as well as with railroads and pipelines. The coordinated efforts of the President's Council on Environmental Quality, the Citizens Advisory Committee on Environmental Quality, and the affected public service industries should provide the most effective level for meeting the challenges of multiple use. (USBR)
W70-03376

WATER SUPPLY TO THERMAL POWER PLANTS,
Sargent and Lundy, Chicago, Ill.
For primary bibliographic entry see Field 03E.
W70-03548

8D. Soil Mechanics

CLEANING OIL CONTAMINATED BEACHES WITH CHEMICALS, A STUDY OF THE EFFECTS OF CLEANING OIL CONTAMINATED BEACHES WITH CHEMICAL DISPERSANTS.
Federal Water Pollution Control Administration, Edison, N.J. Northeast Region Research and Development Program.
For primary bibliographic entry see Field 05C.
W70-03349

THE PRINCIPLE OF REINFORCED EARTH,
Bureau d'Etudes de la Terre Armee, Paris (France).
Henri Vidal.
Highw Res Rec, No 282, p 1-16, 1969. 16 p, 37 fig.

Descriptors: *Reinforcing, *Reinforcement, *Earth, *Earthworks, Foreign design practices, Retaining walls, Theory, Calculations, Economics, Soil mechanics, Soil Engineering, Comparative costs, Comparative benefits, Friction, Tensile stress, Strength, Structures, Stress, Soil strength.
Identifiers: Reinforcing materials, France, Comparative studies, Compressive stress, Flexible structures.

Reinforced earth structures have no height limit, are flexible, simple, and economical to build, and can be designed to support any external forces exerted upon them. Reinforced earth structures are composed of earth, reinforcing disposed in horizontal layers, and a flexible skin facing for retaining the earth particles not in contact with reinforcing strips. Reinforcing elements can be any material possessing the necessary tensile strength and can be any shape giving the necessary friction surface in the required direction. Limitations on earth materials vary with the type of reinforcement used, the general condition being that sufficient friction exists between earth and reinforcement to generate the necessary tensile stresses in the reinforcement. For the conventional type of reinforcement, this condition is met by earth having a friction angle of about 25 deg. The first reinforced earth structures were built in 1964 and have been used for retaining walls, beams, foundation mats, and piers. Many other structures having varying shapes and sizes could be built. Walls to support highways or railways in urban areas, dams, cofferdams, and tunnels in embankments have been proposed or tested and design calculations developed. (USBR)
W70-03359

VIBRATION OF NAVAJO DAM FOLLOWING A SUBSURFACE NUCLEAR BLAST,
Bureau of Reclamation, Denver, Colo.
George C. Rouse, and Louis H. Roehm.
Bur Reclam Rep No DD-9, July 1969. 30 p, 12 fig, 1 tab, 16 ref.

Descriptors: *Earth dams, Structural behavior, *Nuclear explosions, Instrumentation, Earth movements, Frequency, Earthquakes, Resonance, *Vibrations, Bibliographies, Seismic investigations, *Shock waves, *Earthquake engineering, Seismic waves, *Underground explosions, Seismic studies, Damping.
Identifiers: Gasbuggy Project, Navajo Dam (N Mex), Seismic stability, Dam stability, Seismic velocity, Seismic tests, Dynamic response.

In Dec 1967, the Gasbuggy subsurface nuclear blast was detonated about 24 mi southeast of Navajo Dam, a 400-ft-high Bureau of Reclamation rolled-earth structure in New Mexico. The blast generated measurable seismic vibrations at the dam. In accordance with a Reclamation request, the Coast and Geodetic Survey investigated the response of the dam to these vibrations by recording horizontal and vertical velocities for 3 points on the structure. Measured data obtained for the crest and a point on the downstream slope are compared to computed data for the same locations. (USBR)
W70-03370

HYDROLOGIC CAPACITIES OF SOILS IN WATERSHED ENGINEERING,
Agricultural Research Service, Beltsville, Md. Hydrograph Lab.
For primary bibliographic entry see Field 02G.
W70-03493

8E. Rock Mechanics and Geology

PRESTRESSING OF THE LINING OF A HYDROTECHNIC TUNNEL IN A WATERTIGHT ROCK MASS BY GROUTING,
D. Krsmanovic, Z. Langof, and H. Zupcevic.
Rock Mech, Vol 1, No 1, p 71-86, July 1969. 16 p, 9 fig, 1 tab, 6 ref.

Descriptors: Tunnel design, *Tunnel linings, Tunnel pressures, Water tunnels (Conveyance), Tunnels, Pressure conduits, *Pressure tunnels, Hydrostatic pressure, Deformation, *Prestressing, Tensile stress, *Grouting, Foreign design practices, Stress, Water tunnels (Testing), Rock mechanics.
Identifiers: Pressure chamber test, Grout mixes, Yugoslavia, Rama Hydroelec Proj (Yugoslavia), Concrete linings.

The use of grouting to prestress a pressure tunnel lining in a watertight rock mass was investigated with a full-scale test. A 5.0-m-dia by 33-m-long test chamber was set up in a special gallery parallel to the tunnel. The reinforced concrete lining was 50 cm thick. Grouting was applied by a group system grouting 32 boreholes simultaneously. Deformations and stresses in the tunnel lining were measured before, during, and within 2 mo after grouting. The chamber was loaded by internal hydrostatic pressure increased gradually over 11 cycles to a maximum of 13.0 atm. Test results show that prestressing can be achieved satisfactorily by grouting. Tensile stresses developed in the lining at total loadings were very low because of prestressing. (USBR)
W70-03367

CONSOLIDATION AND SEDIMENTATION-COMPRESSION STUDIES OF A CALCAREOUS CORE, EXUMA SOUND, BAHAMAS,
Illinois Univ., Urbana. Dept. of Geology.
Donald G. Miller, and Adrian F. Richards.
Sedimentology, Vol 12, No 3/4, Special Issue, p 301-316, June 1969. 16 p, 4 fig, 1 tab, 36 ref. ONR Contract No 3985 (09).

Descriptors: *Consolidation, *Sediments, *Soil strength, Soil physical properties, Shear, Compressive strength, Cores, Diagenesis, Engineering geology, Carbonate rocks, Particle size.
Identifiers: *Calcareous sediments, *Bahamas.

A comparison is made between the void ratio and pressure relationships resulting from a laboratory consolidation test and a sedimentation-compression computation on a short core of calcareous mud or ooze of low plasticity. Geotechnical measurements of grain size, bulk density, Atterberg limits, water content, vane shear strength, porewater salinity and carbonate content are graphically related to depth in the core. Results of the laboratory consolidation test on this material differ markedly from the in-place relationship between void ratio, or water content, and the effective overburden pressure, or burial depth, shown by the sedimentation-compression curve. The previous maximum consolidation pressure, based on laboratory consolidation test data, is about 60 times greater than the computed in-place effective overburden pressure. An explanation for this difference would include the different magnitudes of time available for consolidation, cementation occurring in-place, and orientation of the constituents. It is suggested that results of the consolidation test on carbonate muds or oozes should be interpreted with caution for geological and engineering purposes. (Knapp-USGS)
W70-03448

8F. Concrete

RESULTS OF FIELD INVESTIGATIONS OF THE QUALITY OF JOINTING PRECAST ELEMENTS OF SARATOV HYDROELECTRIC POWERPLANT,
E. G. Dmitrieva.
Gidrotekh Stroit, No 4, p 22-23, 1966. Transl from Russ, Bur Reclam Transl 706, Sept 1969. 10 p, 2 fig, 3 ref.

Descriptors: Foreign projects, Precast concrete, Reinforced concrete, Concrete technology, Hydraulic structures, *Joints, Foreign research, *Joint fillers, Methodology, Bonding, Concrete mixes, Concrete placing, Concrete testing, Density, *Field control, Field tests, Watertight, *Quality control, Strength, Vibrators (Mechanical).
Identifiers: USSR, Bond strength, Saratov Powerplant (USSR), Vibratory compaction, Construction methods.

The Saratov combined dam and powerplant on the Volga was built from an experimental design, using precast, reinforced concrete elements. The separate elements are joined by placing and vibrating concrete mix in 60-cm-wide joints. Field tests on these joints showed that, with proper technology and equipment, the bond between the concretes of the element and the joint and the density, strength, and watertightness of joint concrete were satisfactory. However, there were many unsatisfactory joints caused by failure to place all concrete in the joint continuously, failure to meet mix specifications, and poor vibration. The recommended technology, when followed, produced the desired results in vertical joints. Additional grouting was necessary for horizontal joints between the monolithic foundation and elements. Adherence to recommended technology must be required, including composition and transportation of mix, placement rate of 8 to 10 cu m/hr, compaction by specified vibrators, maintaining a 16-cm minimum horizontal joint between elements and foundation slab, and pressurization of mix between components supported by special posts. (USBR)

W70-03371

CONTROLLED CHANGES IN THE PROPERTIES OF CONCRETE AND REINFORCED CONCRETE BY MEANS OF POLYMERS,
S. S. Davydov.
Beton i zhelezobeton, Vol 15, No 5, p 1-3, 1969. Transl from Russ, Bur Reclam Transl 606, Sept 1969. 9 p.

Descriptors: *Concrete technology, *Polymers, *Plastics, Admixtures, Reinforced concrete, Reinforcing, Chemical stability, Aggregates, Hardening, Physical properties, Mechanical properties, *Materials engineering, *Building materials, Cements, Foreign research.
Identifiers: *Concrete-polymer materials, Concrete products, USSR, *Polymer concretes, Epoxy concretes, Plastic coatings.

Soviet institutes involved in advancing structural sciences have developed plastic cements and concretes capable of overcoming the limitations of conventional concretes. For more diversified and larger structures, modern construction requires materials that are strong, flexible, impact- and abrasion-resistant, chemically stable, and unsusceptible to cracking or surface deterioration. By changing the composition and quantity of components, plastic-concretes can be designed to meet specific needs. Soviet research has studied many plastic additives and admixtures for binders and concretes, as well as polymer coatings, laminated structures, and synthetic glues. Polymer concretes from furfural acetate monomers, hardened by benzenesulfonic acid, were studied extensively and are now being used for underground, mining, municipal, industrial, and transport construction. Problems that need resolving to reduce variations in results and costs, and research conducted in this direction are discussed. (USBR)
W70-03372

8G. Materials

DEVELOPMENT AND EVALUATION OF STANDARD TEST METHODS, THE ROLE OF STATISTICAL DESIGN OF EXPERIMENTS,
Purdue Univ., Lafayette, Ind.
Grant Wernimont.
Mater Res Stand, Vol 9, No 9, p 8-20, 64 and 66, Sept 1969. 15 p, 11 fig, 7 tab, 40 ref.

Descriptors: *Materials testing, *Specifications, *Measurement, *Testing, *Statistical methods, Materials engineering, Variability, Quality control, Tolerances (Mechanics), Test procedures, Test specimens, Sampling, Experimental data, Statistical analysis, Statistics, Bibliographies, Control.
Identifiers: *Test results, Experimental design, Experimentation, Statistical quality control, Accuracy.

Specification testing and statistic design of testing experiments were studied by ASTM Committee E-11 on Statistical Methods. Concepts are presented on the ability of a testing process to discriminate materials that conform to specified tolerances from those that do not. Materials sampling and testing operations are discussed. Considerations involved in the design of testing experiments are given for control within a laboratory and among different laboratories. Strategies are suggested for designing, executing, and interpreting experiments to study the variability of materials, to find and control the variations in test results within and among laboratories, and to estimate components of variance for the material being tested. ASTM Committee E-11 believes that statistical design of experiments is important in preparing standards for materials and test procedures but is subordinate to the technology and art of making measurements. The committee, concerned with the general problem of applying statistical methodology, serves as a consultant to other ASTM committees on specific problems. (USBR)
W70-03354

POLARIZATION METHODS FOR MEASURING THE CORROSION OF METALS BURIED UNDERGROUND,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.; and Kaiser Aluminum and Chemical Corp., Spokane, Wash.
D. A. Jones, and T. A. Lowe.
J Mater, Vol 4, No 3, p 600-617, Sept 1969. 18 p, 9 fig, 1 tab, 18 ref.

Descriptors: *Corrosion, *Corrosion control, *Polarization, Aluminum, Testing, Electrochemistry, Steel, Experimental data, Field tests, Test procedures, Measuring instruments, Bridges (Electric), Bibliographies, Polarographic analysis, Electrical resistivity, Metals.
Identifiers: *Underground corrosion, Corrosion environments, Corrosion current, *Corrosion tests, Buried metalwork, Comparative studies.

Corrosion of buried metal equipment cannot be measured easily without removal for inspection. Even then, weight loss tests may be impractical, and visual inspection gives only a qualitative appraisal of corrosion. Electrochemical polarization methods give a numerical value of corrosion rate and can be conducted remotely, leaving the corroding specimen undisturbed. An investigation was made to compare various polarization methods for measuring the corrosion rate of buried metal. The Schwerdtfeger polarization-break method and the Stern polarization-resistance method were compared on buried aluminum and steel. Polarization resistance data are easier to interpret and should be more reliable for comparing corrosion rates calculated by various investigators. In conducting the polarization experiments, ohmic contributions from measured polarization potentials were removed by using the Holler bridge circuit. Relatively low 100-kilo-ohm resistors in the bridge circuit did not appreciably affect calculated corrosion rates, although the resistors did permit polarization of the reference electrode in the circuit. (USBR)
W70-03365

OIL AND GAS.

Tenn Code Ann sec 60-202 (1956).

Descriptors: *Tennessee, *Wells, *Well casings, *Oil wells, Drilling, Saline water intrusion, Well regulations, Natural gas, Oil, Saline water, Mineral water, Construction materials, Stell, Iron, Fresh water, Groundwater, Legislation, Regulation.
Identifiers: *Gas sand, *Wrought iron.

A well drilled into oil and gas sand for the production of petroleum oil, natural gas, salt water, or mineral water must be encased with wrought iron, steel, or metal casing before drilling in order to exclude all surface water, salt water or fresh water from reaching the oil and gas sand. (Powell-Florida)
W70-03425

8H. Rapid Excavation

NUCLEAR EXCAVATION: REVIEW AND ANALYSIS,
L. J. Circei, Jr.
Eng Geol, Vol 3, p 5-59, 1969. 55 p, 25 fig, 4 tab, 88 ref.

Descriptors: *Craters, *Nuclear explosions, *Underground explosions, Excavation, Rock excavation, Nuclear energy, Reviews, Safety, Canals, Radiation hazards, Harbors, Reservoir construction, Panama Canal, Cuts aggregates, Landslides, Bibliographies, Construction.
Identifiers: *Nuclear excavation, *Plowshare Operation, *Rapid excavation, Construction methods.

Nuclear cratering technology has advanced to such a state that meaningful predictions of crater and channel sizes in selected media can be made with confidence. Continuing research is underway to extend basic cratering knowledge to saturated, fine-grained, and stratified media. Significant advances have been made in evaluating the magnitude and extent of safety hazards associated with underground nuclear cratering detonations. Many excavation projects for harbors, reservoirs, canals, and aggregate production are feasible. Nuclear excavation provides a method for alleviating potentially catastrophic situations that could result from floods, landslides, and volcanoes. The development of nuclear excavation into a standard engineering tool will be determined by factors not related entirely to technical feasibility. Political and social pressures will weigh heavily in the ultimate acceptance. (USBR)
W70-03362

VIBRATION OF NAVAJO DAM FOLLOWING A SUBSURFACE NUCLEAR BLAST,
Bureau of Reclamation, Denver, Colo.
For primary bibliographic entry see Field 08D.
W70-03370

MEASURING UNDERGROUND-EXPLOSION EFFECTS ON WATER LEVELS IN SURROUNDING AQUIFERS,
Geological Survey, Denver, Colo.
M. S. Garber, and L. E. Wollitz.
Groundwater, Vol 7, No 4, p 3-7, July-Aug 1969. 5 p, 10 fig, 6 ref.

Descriptors: *Underground explosions, *Aquifers, Groundwater, Effects, Measurement, Water levels, *Water level fluctuations, Water wells, Water table, Wells, Forecasting, *Nuclear explosions, Aquifer characteristics, Transducers, Instrumentation, Oscillographs.
Identifiers: Water-level recorders, Explosive construction, Packings, Plowshare Operation, Pressure transducers.

Underground detonations may produce observable effects in surrounding aquifers and wells. The nature and duration of the effects at any observation point depend on: (1) the amount of energy released by the detonations, (2) the geologic environment, (3) the position of the buried explosive device in relation to the saturated zone, (4) aquifer characteristics, and (5) the distance from point of detonation. Precise measurement of the effects in wells presented numerous technical problems, resulting in the development of specialized techniques. Initially, the effects were observed by measuring the fluctuation of the free water surface in wells; the current technique employs high-resolution pressure transducers deep in the water column. Pneumatic packers may be used to restrict the movement of water into the well. Data are recorded on high-speed oscillographs. (USBR)
W70-03375

8I. Fisheries Engineering

CONSERVATION OF NATURAL RESOURCES (FISHING).
For primary bibliographic entry see Field 06E.
W70-03407

GAME AND FISH COMMISSION (GAME AND FISH MANAGEMENT AND CONSERVATION).
For primary bibliographic entry see Field 06E.
W70-03590

10. SCIENTIFIC AND TECHNICAL INFORMATION

THE WATER RESOURCES SITUATION IN PUERTO RICO: AN EVALUATION OF PUBLISHED INFORMATION,
Puerto Rico Univ., Mayaguez. School of Engineering.
For primary bibliographic entry see Field 06B.
W70-03245

ECOLOGICAL TECHNIQUES UTILIZING RADIONUCLIDES AND IONIZING RADIATION - A SELECTED BIBLIOGRAPHY,
Washington State Univ., Pullman. Dept. of Zoology.
For primary bibliographic entry see Field 07B.
W70-03308

BUILDING A COMPUTER-BASED MIS,
Terminal and Display Systems, Inc.
James M. McKeever.
J Syst Manage, Vol 20, No 9, p 12-17, Sept 1969. 6 p, 6 fig.

Descriptors: *Data storage and retrieval, *Data storage systems, *Information retrieval, Data collection systems, Data processing, Technology, Systems analysis, Planning, Methodology, Operations research, Computers, Integration, Management, Decision making, Control, Communication, Requirements.
Identifiers: *Computer-based systems, *Information systems, Systems engineering, Man-machine systems, Data elements.

A computer-based management information system (MIS) cannot be implemented successfully unless an organization concedes that management: (1) has an information problem, (2) wants to solve the problem, and (3) is willing to commit the resources for a solution. Five basic steps in designing an MIS are: (1) understanding and approving the objectives of the system by top management, (2) determining information requirements, (3) designing a data base, (4) designing or acquisitioning software, and (5) selecting new or modifying existing hardware. The 5 steps should be performed in the order listed, although there will be some overlap and parallel activity. An MIS must not remain static. The best examples of management information systems show that new data files should be added to the system, old data files no longer used should be removed from the system, and the contents of remaining data files should be changed frequently to reflect the information needs of management. These needs will come to light only after management has had experience using the system. (USBR)
W70-03360

CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO WATER QUALITY STATIONS,
Geological Survey, Washington, D.C. Office of Water Data Coordination.
For primary bibliographic entry see Field 07C.
W70-03473

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SELECTED WATER RESOURCES ABSTRACTS

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SELECTED
WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

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MAY 15, 1970

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Use of funds for printing this publication approved by the Director of the Bureau of the Budget, September 4, 1968.

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

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2. WATER CYCLE

A. General

ONTRIBUTION OF ISOTOPE TECHNIQUES O THE STUDY OF SOME HYDROLOGICAL ROBLEMS,
ternational Atomic Energy Agency, Vienna Austria).
ryan R. Payne.
: Isotope Techniques in the Hydrologic Cycle, eophysical Monograph Series, No 11, American eophysical Union, p 62-68, 1967. 7 p, 4 fig.

escriptors: *Radioisotopes, *Radioactivity chniques, *Tritium, *Deuterium, Precipitation tmospheric), Lakes, Hydrogeology, Groundater recharge, Groundwater movement, Surveys.
entifiers: Turkey, Kenya, Jamaica, Austria, Interational Atomic Energy Agency.

me of the hydrogen and oxygen isotope studies hydrology in which the International Atomic nergy Agency is currently engaged in Turkey, enya, Jamaica and Austria are outlined. Variaons in concentration of tritium, deuterium and oxgen 18 were measured in precipitation, lakes, and roundwater in different regions and the results ave been applied to the solution of some ydrological problems including the turnover time f lakes, the interconnections between different ater bodies, location of recharge areas, and the ansient times since recharge. Isotope techniques an provide useful information for a better unerstanding of hydrological and hydrogeological roblems. (Carstea-USGS)
/70-03694

NUMERICAL MODEL FOR THE YDROLOGIC TRANSPORT OF RADIOACIVE AEROSOLS FROM PRECIPITATION TO /ATER SUPPLIES,
tanford Univ., Calif. Dept. of Civil Engineering.
ale D. Huff, and Paul Kruger.
: Isotope Techniques in the Hydrologic Cycle, eophysical Monograph Series, No 11, American eophysical Union, p 85-96, 1967. 12 p, 4 fig, 2 ib, 22 ref. USPHS Res Grant ES-00047-01.

escriptors: *Radioactivity techniques, *Mathetatical models, *Aersols, *Hydrologic cycle, Path of pollutants, Precipitation (Atmospheric), /ater supply, Radioisotopes, Runoff, Watersheds Basins), Hydrographs, Rainfall-runoff relationips, Numerical analysis.
dentifiers: *Radioactive aerosols.

reparation is underway of a numerical model of ne transport of nuclear debris from the atosphere by precipitation through the surfaceater portion of the hydrologic cycle. The model ollates the significant parameters involved, such s the physical and chemical properties of biologially important radionuclides in aerosols, their eposition by precipitation under Pacific coast yclonic conditions, and their movement through ne catchment basin during precipitation and ruoff. The model is based upon the quantitative estiation of these parameters under conditions given y an existing computer model which traces the ovement of water through the basin to predict the unoff hydrograph. The numerical model should erve as an index of predictability for radionuclide oncentration in water supplies originating from atospheric sources and as a means to locate areas here additional numerical knowledge of ydrologic processes is needed. (Carstea-USGS)
/70-03698

A MOSAIC TECHNIQUE FOR GENERATING HE DAILY PATTERN WITHIN A SYNTHETIC LOW SEQUENCE,
Welsh Coll. of Advanced Technology, Cardiff; and Water Research Association, Medmenham (England).
G. J. Cockell, and J. A. Cole.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 36, p 277-282, 1967. 6 p, 1 tab, 4 ref, append.

Descriptors: *Rainfall-runoff relationships, *Mathematical models, *Synthetic hydrology, *Probability, Markov processes, Hydrologic data, Unit hydrographs, Streamflow forecasting, Runoff forecasting, Discharge (Water), Computer programs.
Identifiers: Watershed models.

A realistic pattern of daily flows may be required for a month, in which the total flow has been synthetically determined by a Markov chain model. The mosaic technique does this by selecting specimen months from historical daily rainfall or river discharge records, giving the required total monthly runoff. By having two sets of specimen months, wit higher and lower than average runoff at the start of the month, juxtaposition of unduly disparate flows at the transition from one month to the next may be avoided. The technique is illustrated with the use of 40 specimen months of rainfall record in a river's headwaters. Seasonal runoff upon rainfall regression effect the conversion to daily available flows. They are then transformed by unit hydrographs to give the allocation of daily flows of the river and its tributaries at various downstream sites. An appendix details the computer program in Algol which operates the mosaic technique. (Knapp-USGS)
W70-03704

ON THE FLUCTUATION OF WATER RESOURCES,
Kyoto Univ. (Japan). Disasters Prevention Research Inst.
Masami Sugawara.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 45, p 344-353, 1967. 10 p, 5 fig, 1 tab, 1 ref.

Descriptors: *Streamflow forecasting, *Reservoir operation, *Statistical methods, *Time series analysis, *Water management (Applied), Fourier analysis, Frequency analysis, Statistical models, Reservoir yield.
Identifiers: *Spectral analysis.

Hydrological data such as river discharge, precipitation, etc., show large fluctuation with time, while demand on water is approximately constant with time. To take the constant demand out of the fluctuating supply, we construct reservoirs. Draft-storage relations must depend on the fluctuations of supply. Moreover, they must depend on the spectral structure of the supply, regarded as time series. If the supply fluctuates mainly in high frequency regions, it may be smoothened by small reservoirs, but if the supply has a long period on the order of years, it is very difficult to smooth fluctuations. From this standpoint a spectral analysis of hydrological data was made using mainly monthly precipitation. Contrary to expectation, no significant cycle, except seasonal change, could be found. From an analysis of monthly precipitation of about a century, we conclude that this time series is a composition of seasonal pattern and random noise. As the time series of this type is not suitable for mathematical analysis, a numerical method is used to find the relation between the capacity of reservoir and the amount of water demand. (Knapp-USGS)
W70-03705

STOCHASTIC ASPECTS OF RESERVOIR STORAGE,
Manchester Univ. (England). Inst of Science and Technology.
J. B. White.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 46, p 354-360, 1967. 7 p, 16 ref.

Descriptors: *Streamflow forecasting, *Reservoir operation, *Statistical methods, *Water management (Applied), *Stochastic processes, Markov processes, Statistical models, Mathematical models, Synthetic hydrology, Reservoir yield, Probability.
Identifiers: Reservoir storage models.

The application of stochastic theory to reservoir storage processes (the Markov chain concept) has enabled these processes to be accurately described. An account of the findings is given. Earlier methods are then reviewed and it is shown that they are unsound in principle because either finite capacity of reservoir is ignored or annual and seasonal depletions are treated separately. Nevertheless comparison with the new approach suggests that the earlier methods may give acceptable results in cases where the probability of emptying is low. (Knapp-USGS)
W70-03706

CYCLIC FLUCTUATIONS OF VARIABILITY IN HYDROLOGIC PHENOMENA,
Water Conservancy Board, Prague (Czechoslovakia).
Oldrich Vitha, and Vladmir Soucek.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 51, p 389-396, 1967. 8 p, 5 fig, 2 tab, 3 ref.

Descriptors: *Streamflow forecasting, *Rainfall-runoff relationships, *Statistical methods, Stochastic processes, Time series analysis, Frequency analysis, Runoff forecasting, Reservoir operation, Reservoir yield, Water management (Applied).
Identifiers: Watershed models.

Investigations are made of the dependence of basic statistical parameters expressing the regime of long-term variations of runoff and precipitation series. Mathematical tests show that the mean cycle of sunspots influences the distribution, and the variability of runoff and precipitation series. Relations are verified by comparing the results from real and random artificially established runoff series. A scheme of practical use is given with an example of the calculation of the effect of a reservoir with multiyear outflow control. (Knapp-USGS)
W70-03711

SUNSPOTS AND HYDROLOGIC TIME SERIES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
Ignacio Rodriquez, and Vujica Yevjevich.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 52, p 397-405, 1967. 9 p, 6 fig, 1 tab, 4 ref. NSF Grant GK-169.

Descriptors: *Hydrologic cycle, *Time series analysis, *Precipitatior (Atmospheric), *Runoff, Correlation analysis, Streamflow, Frequency analysis, Statistical methods, Rainfall disposition.
Identifiers: *Hydrologic time series, *Sunspots.

The relationship of hydrologic series of monthly precipitation, annual precipitation and annual runoff to sunspot numbers was investigated by cross-correlation analysis for various time lags (zero lag included) and by cross-spectral analysis. A total of 88 series of monthly precipitation and 174 series of annual precipitation (stations from Western United States), and 16 series of annual flows (stations from several parts of the world) were used as research data. No significant correlation was found between these hydrologic series and sunspot numbers. In fact, the spectrum of sunspot numbers proved to be nearly identical to the spectrum of residuals, when the values of hydrologic series were deduced from the values of sunspot series in order to obtain residuals. The coherence graphs worked out are within confidence limits that indicate there are no relationships between hydrologic series and sunspot numbers. Sampling fluctuations of cross-correlation coefficients between hydrologic series and

sunspot numbers increase when both series are smoothed by moving average schemes. Therefore, when the confidence limits of unsmoothed series are used in the smoothed series approach, incorrect conclusions may be drawn about the significance of correlations. (Knapp-USGS)
W70-03712

APPLICATIONS OF MONTE CARLO METHOD TO RESERVOIR DESIGN,
Institute of Water Resources Research, Berlin (East Germany).
Siegfried Dyck, and Michael Schramm.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 53, p 406-413, 1967. 8 p, 5 fig, 1 tab, 5 ref.

Descriptors: *Reservoir design, *Streamflow forecasting, *Time series analysis, *Reservoir yield, Reservoir operation, Water management (Applied), Statistical methods, Runoff forecasting.
Identifiers: Watershed models.

In applying the Monte Carlo Method to reservoir design long time series of discharge may be generated, using the method proposed by Svanidze. First, two arrangements for the correlation function are considered. Then the serial correlation coefficient between yearly river flows are calculated. To examine the connection between annual river flow and subannual changes of flow for the observed station the range of the residual mass curve of monthly flows is used. When generating time series according to the used method, negative river flows are sometimes obtained. (Knapp-USGS)
W70-03713

SECTION I, INTRODUCTION; SECTION II, DETERMINATION OF DESIGN DISCHARGE; SECTION IX, APPENDIX.
Knowlton-Ratliff-English, Fort Worth, Tex.
For primary bibliographic entry see Field 08A.
W70-03815

THE EFFECT OF SOIL MOISTURE ON INFILTRATION AS RELATED TO RUNOFF AND RECHARGE,
Saskatchewan Univ., Saskatoon. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 02G.
W70-03884

ERRORS IN DISCHARGE ESTIMATES ON MOUNTAIN STREAMS,
Ontario Agricultural Coll., Guelph. School of Agricultural Engineering.
W. T. Dickinson.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 71, p 573-580, 1967. 8 p, 2 tab, 4 ref. Bureau of Reclamation Contract No 14-06-D-5299.

Descriptors: *Streamflow forecasting, *Rainfall-runoff relationships, Data processing, Statistical methods, Evaluation, Stage-discharge relations, Discharge measurement, Estimating, Least squares method, Regression analysis.
Identifiers: Error analysis.

A mathematical representation is given to the stage-discharge relationship, and found to account for virtually all of the variability in sample data for 9 mountain stream-gaging stations in Colorado. The concept of a divisive discharge value is introduced to separate the rating curve into 2 portions; one along which the relative error is practically constant; and the other along which the absolute error remains constant. Confidence and tolerance limits are established for estimated rating curves, and used for inferences regarding the error bounds on daily discharge estimates and future discharge measurements. Consideration is given to the correlation between errors in single discharge estimates, and estimates are made regarding the error bounds on monthly, semiannual, and annual discharge determinations. (Knapp-USGS)
W70-03889

LARGE-SCALE UTILIZATION OF TRITIUM IN HYDROLOGIC STUDIES,
Stockholm Univ. (Sweden). International Meteorological Inst.
Erik Eriksson.
In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 153-156, 1967. 4 p, 8 ref. Atomic Energy Commission Contract AT (30-1)-2458.

Descriptors: *Hydrologic properties, *Radioisotopes, *Tritium, *Tracers, *Radioactivity techniques, Water circulation, Hydrologic data, Sea water, Mixing, Aquifer characteristics, River basins, Reservoirs, Precipitation (Atmospheric), Hydrologic cycle, Hydrogeology.
Identifiers: Hydrologic research.

Tritium is an excellent tracer for circulation of water in nature in many of its phases and is indispensable as a research tool during the Hydrologic Decade. The currently available data make it possible to study some large-scale phenomena like rate of exchange of water across the sea surface and rate of the exchange between sea surface water and deeper sea water. The hydrologic characteristics of river basins can also be studied, as well as similar characteristics of groundwater reservoirs. In these cases the characteristics, suitably defined, are revealed by the distortion of the tritium pulses in precipitation, which occur when water is passing through reservoirs. For full utilization of large-scale tritium as a tracer in hydrologic studies, it is necessary to collect data over many years. (Carstea-USGS)
W70-03894

WATER TRACING IN THE HYDROLOGIC CYCLE,
International Atomic Energy Agency, Vienna (Austria).
L. L. Thatcher.
In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 97-108, 1967. 12 p, 11 fig, 2 tab, 13 ref.

Descriptors: *Hydrologic cycle, *Tracers, *Radioisotopes, Tritium, Deuterium, Oxygen, Carbon, Water circulation, Groundwater movement, Pump testing, Stratified flow.
Identifiers: *Water tracing, Chemical tracers, Oxygen-18, Carbon-14.

The use of tritium, deuterium, oxygen 18, and carbon 14 to represent circulation on the continental and hemispheric scale gives new significance to the tracing of water movement through the hydrologic cycle. The traditional concept of tracers as limited tools to obtain data about micro-areas within extensive aquifers (analogous to measuring permeability on core samples to obtain the permeability of an aquifer) is outdated by the newer techniques. The tracers of interest for investigation of the hydrologic cycle are introduced on the grand scale by natural processes and fallout, and the data obtained by observing their distributions represent integrations of transport processes over large areas. Radioisotopes have also contributed to the investigation of the local or micro-aspects of the hydrologic cycle. Radioisotope tracers have been substituted for chemical tracers in groundwater velocity and direction measurements, the investigation of stratified flow, directional information from pumping tests, and similar studies. (Carstea-USGS)
W70-03900

EFFECTS OF INCONSISTENCY AND NON HOMOGENEITY ON HYDROLOGIC TIME SE RIES,
Colorado State Univ., Fort Collins. Dept. of Civ Engineering.
Vujica Yevjevich, and Raymond I. Jeng.
French resume included. Proceedings of Interna tional Hydrology Symposium, Sept 6-8, 196 Colorado State Univ, Fort Collins, Vol 1, Paper 5 p 451-458, 1967. 8 p, 5 fig, 1 tab. NSF Grant GK 169.

Descriptors: *Streamflow forecasting, *Time serie analysis, Rainfall-runoff relationships, Statistica methods, Probability, Correlation analysis
Identifiers: Hydrologic time series.

The effect of inconsistency (systematic errors) an non-homogeneity of data (which are created b man-made or natural changes in environment) o properties of hydrologic variables and time serie was investigated. It was assumed that inconsistenc and nonhomogeneity are in the form of constan and linear jumps, linear and polynomial trends, an combinations thereof. Independent variables ar used with superposed jumps and trends. Changes i probability density functions, in their mean, var ance, skewness, kurtosis, and serial correlatio coefficients were determined for various cases o jumps and trends. Inconsistency and non homogeneity introduce dependence into indepen dent time series, with the first serial correlatio coefficient becoming mainly positive. As hydrolog ic time series are often subject to inconsistency an nonhomogeneity, a portion of positive dependenc in such series comes also from these two factors apart from other basic physical processes in nature (Knapp-USGS)
W70-03905

THE BAYES METHODS OF STATISTICA HYDROLOGY (FRENCH),
Electricite de France, Chatou. Centre d Recherches et d'Essais.
J. Bernier.
English synopsis included. Proceedings of Interna tional Hydrology Symposium, Sept 6-8, 196 Colorado State Univ, Fort Collins, Vol 1, Paper 5 p 459-470, 1967. 12 p, 4 fig, 3 tab, 4 ref.

Descriptors: *Rainfall-runoff relationship *Frequency analysis, Statistical methods, Time se ries analysis, Probability, Estimating.
Identifiers: *Bayes methods, Hydrologic statistics.

Frequency analysis of rainfall-runoff data is ofte criticized because of use of incomplete informatio for the fitting of frequency curves. Bayes method are used to overcome these objections. Th methods are outlined and some practical example are given for illustration. (Knapp-USGS)
W70-03906

HYDROLOGIC EFFECTS OF RAINFALL AUG MENTATION,
Stanford Univ., Calif. Dept. of Civil Engineering.
Alan M. Lumb.
Technical Report No 116, Nov 1969. 114 p, 54 fig 5 tab.

Descriptors: *Cloud seeding, *Hydrology, *Mode studies, Computer simulation, Runoff, Floods Evapotranspiration, Soil moisture, Reservoi storage.

Computer simulation is employed to determine th hydrologic consequences of a 10 percent increas in precipitation as a result of cloud seeding. Tw assumptions concerning the time distribution of th increase are made: (1) the increase is uniformly distributed over all hours of precipitation and (2 larger percentage increases occur during hour when precipitation is low and smaller percentage increases are added to high intensity rainfall Streamflow is simulated for the period of available rainfall record on three watersheds in Nev Hampshire and California. Data on the effect o

infall increases on total runoff, interflow, groundater flow, soil moisture accumulation, actual vapotranspiration, and flood peaks are presented or the three watersheds. A relationship appears to xist between the ratio of annual runoff to recipitation and the percentage of annual rainfall iat becomes runoff and evapotranspiration. The ffect on soil moisture storage is found to be small. he increase in the mean annual flood peak and the tandard deviation of the annual flood peaks is ound to be a function of the percentage of recipitation that results in surface runoff and inerflow with larger increases when this percentage s low. The assumption as to the distribution of ainfall increases among the hours of rainfall is ound to have significant effect on flood peaks, but o have very little effect on total runoff volume or vapotranspiration. Generalized procedures are resented to permit an estimate of the hydrologic onsequences of a 10 percent increase in rainfall n any watershed if mean annual precipitation and nean annual runoff are known. It is shown that it is ossible to estimate the additional usable water obainable from a 10 percent increase in rainfall for reservoirs of various sizes on a given watershed. (Linsley-Stanford)
W70-03931

2B. Precipitation

POINT RAINFALL FREQUENCIES IN CONVECTIVE STORMS,
Arizona Univ., Tucson.
Martin M. Fogel, and Lucien Duckstein.
Water Resources Research, Vol 5, No 6, p 1229-1237, Dec 1969. 9 p, 9 fig, 2 tab, 10 ref.

Descriptors: *Precipitation (Atmospheric), *Rainfall disposition, *Frequency analysis, *Rain gages, Statistical methods, Networks, Rainfall intensity, Topography, Rainfall-runoff relationships, Probability, Depth-area-duration analysis.
Identifiers: Rainfall frequency, Convective storms.

An exponential relation was developed to describe the spatial distribution of convective storm rainfall in southwestern United States. A geometric distribution was used to describe the frequencies of point rainfall depths. A Poisson distribution was assumed to represent the probability of at least one storm center occurring over a given area a specified number of times during a season. Assuming that the two probability distributions are independent and uncorrelated, maximal and minimal distributions of point rainfall depths were derived. The minimal distribution indicates that with a very high certainty a single rain gage will miss at least one convective storm a year. When compared with frequencies determined from long-term historical records, the maximal distribution exhibits a similar mean, a greater variance, and lower recurrence intervals for the higher rainfall depths. (Knapp-USGS)
W70-03673

THE APPLICATION OF ISOTOPES TO SOME PROBLEMS IN ATMOSPHERIC SCIENCES,
Atomic Energy Commission, Washington, D.C. Biology and Medicine Div.
Eugene W. Bierly.
In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 37-46, 1967. 10 p, 3 fig, 1 tab, 34 ref.

Descriptors: *Radioisotopes, *Tracers, *Meteorology, *Radioactivity techniques, Nuclear explosions, Atmospheric physics, Diffusion, Balloons, Mixing, Vortices, Meteorology.
Identifiers: *Nuclear meteorology, Troposphere, Stratosphere.

Isotopes have been used in tracing the global transport and diffusion of nuclear weapons debris and the motions of the stratosphere and troposphere through sampling by high altitude balloons and aircrafts. In the stratosphere, the tungsten 185 cloud indicated that large scale quasi-horizontal mixing was the dominant transport mechanism. The axes of mixing are inclined to the horizontal and follow clearly the surfaces of potential vorticity. In the troposphere, the peak concentrations in the north-south profiles of nuclear debris occur at 30 deg north or south and not at the latitude of origin, and sometimes the material is transported rapidly over great distances before being deposited on the ground. Nuclear meteorology was useful in studying exchanges between stratosphere and troposphere, and also between hemispheres. Meso- and microscale studies include: (1) Measurement of lateral and vertical diffusion coefficients of effluent flumes; (2) measurement of AgI paths when the AgI is used as a cloud-seeding agent; (3) scavenging of small particles by precipitation; and (4) deposition studies. (Carstea-USGS)
W70-03690

DIFFUSIOPHORETIC AND THERMOPHORETIC EFFECTS ON PARTICULATE MATTER NEAR CONDENSING AND EVAPORATING WATER SURFACES,
Atomic Energy Research Establishment, Didcot (England).
Phillip Goldsmith.
In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 55, 1967. 1 p.

Descriptors: *Radioactivity techniques, *Diffusion, *Evaporation, *Thermal properties, *Water vapor, Condensation, Soil moisture, Soil water movement, Tracers, Aerosols, Thermocline.
Identifiers: *Water vapor diffusion, Diffusiophoretic velocity, Thermophoretic velocity.

Radioactive tracer techniques have been used to study the velocity induced on submicron aerosol particles by diffusing water vapor. Similar experiments have also been made on their velocity in temperature gradients. Often in nature, diffusing water vapor is associated with a temperature gradient in the carrier gas, for instance near a cool surface on which water is condensing. Further measurements have been carried out on the superimposed diffusiophoretic and thermophoretic velocities. The role of these mechanisms in the scavenging of particulate matter from the atmosphere is discussed in the light of these experiments. (Carstea-USGS)
W70-03691

THE ATMOSPHERIC TRANSPORT OF TRITIUM,
Stockholm Univ. (Sweden). International Meteorological Inst.
Erik Eriksson.
In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 56-57, 1967. 2 p.

Descriptors: *Tritium, *Radioisotopes, *Tracers, *Radioactivity techniques, Precipitation (Atmospheric), Atmospheric physics, Nitrogen, Oxygen, Atmosphere, Nuclear explosions, Runoff, Mixing, Oceans, Water vapor.
Identifiers: *Tritium circulation.

Prior to 1954, tritium was derived in nature entirely from cosmic-ray interaction with nitrogen and oxygen in the atmosphere. Since 1954, considerable amounts of tritium have been injected into the stratosphere in nuclear weapons tests. Tritium circulation in nature differs rather substantially from that of water. Further, the relative intensities of deposition of water and tritium are different. The net rate of tritium deposition on land is determined to a large extent by the total runoff from land. Over ocean areas, the deposited tritium will mix with a large quantity of water which will maintain a very low concentration of tritium in water vapor. The rate of removal over oceans is very effective and roughly 3 times as large as the rate of removal by precipitation. The concentration of tritium in precipitation over oceans will be much lower than that over land. (Carstea-USGS)
W70-03692

HURRICANE TRITIUM I: PRELIMINARY RESULTS ON HILDA 1964 AND BETSY 1965,
Miami Univ., Fla. Inst. of Marine Science.
H. Gote Ostlund.
In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 58-60, 1967. 3 p, 2 fig, 1 tab, 3 ref. NSF Grant GP-4534.

Descriptors: *Hurricanes, *Radioisotopes, *Radioactivity techniques, Water vapor, Tritium, Analytical techniques, Sea water, Mixing, Tropical regions, Atmospheric physics, Tracking techniques.
Identifiers: *Hurricane Hilda, *Hurricane Betsy, Low-level counting techniques.

Airborne systems were built for sampling of liquid water and water vapor for a study of tritium distribution in and around hurricanes. Refined low-level counting techniques were developed for extremely low tritium assays and specific activities. An electrolytic enrichment system utilizing the periodic addition method is available. The air seemed to be vertically well mixed in most areas. The tritium concentration in water vapor of undisturbed tropical air is roughly 10 times higher than that of surface sea water. When this air is entrained into a hurricane, the tritium concentration decreases approaching the eye. (Carstea-USGS)
W70-03693

A NUMERICAL MODEL FOR THE HYDROLOGIC TRANSPORT OF RADIOACTIVE AEROSOLS FROM PRECIPITATION TO WATER SUPPLIES,
Stanford Univ., Calif. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-03698

AN ANALYSIS OF RUNS OF PRECIPITATION EVENTS,
North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering.
For primary bibliographic entry see Field 07C.
W70-03702

A MODEL FOR GENERATING SYNTHETIC SEQUENCES OF SHORT-TIME-INTERVAL RAINFALL DEPTHS,
Massachusetts Inst. of Tech., Cambridge.
R. A. Grace, and P. S. Eagleson.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 35, p 268-276, 1967. 9 p, 4 fig, 1 tab, 5 ref.

Descriptors: *Rainfall, *Forecasting, *Synthetic hydrology, *Simulated rainfall, *Mathematical models, Probability, Simulation analysis, Digital computers, Computer programs, Computer models.
Identifiers: Rainfall data.

An analytical model is developed for the synthesis of short-time-interval sequences of rainfall data. The model uses the probability distribution of the time between storms and the storm duration as well as an equivalent joint distribution of storm rainfall depth and duration to generate sequences of lumped storms which retain the stochastic features of the historical storm data. The prescribed total storm depths are then distributed over their respective durations by using a special type of urn model in such a way that the short-time-increment rainfall sequences within synthetic storms possess, on the average, the same serial correlation and percentage mass characteristics as their historical counterparts. Probability distributions and storm characteristics are obtained from 10-min summer rainfall data for a period of 5 years at St. Johnsbury, Ver-

mont. These sequences are extended synthetically, and the characteristics of the synthetic storm are shown to agree adequately with the historical attributes. Not only does the model give valid results, but it does so quickly, since it is possible to compile the necessary computer programs and then generate 15 summers of lumped storms or 5 summers of 10-min data in 3 minutes. (Knapp-USGS)
W70-03703

ELEVATION EFFECTS ON RAINFALL NEAR HOLLIS, ALASKA,
Forest Service (USDA) Juneau, Alaska. Pacific Northwest Forest and Range Experiment Station.
W. J. Walkotten, and J. H. Patric.
USDA Forest Serv Res Note PNW-53, 1967. 8 p, 2 fig, 2 tab, 7 ref.

Descriptors: *Elevation, *Rainfall, Alaska, *Precipitation (Atmospheric), Meteorology, Altitude, Topography.

Records for 21 storms, ranging from 0.04 to 2.66 inches at sea level, over elevations from sea level to 1,100 feet showed an average rainfall increase of 0.02 inches per 100 feet of elevation. (Helmers-Forest Service)
W70-03820

A METHOD FOR STATISTICAL EVALUATION OF WEATHER MODIFICATION AT THE RIVER FLOW CONTROL LEVEL,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 03B.
W70-03848

EXTENSION OF RAINFALL RECORDS BY INTERSTATION CORRELATION,
Stanford Univ., Calif. Dept. of Civil Engineering.
For primary bibliographic entry see Field 07A.
W70-03932

2C. Snow, Ice, and Frost

FRACTURE OF LAKE AND SEA ICE,
Army Terrestrial Sciences Center, Hanover, N.H.
W. F. Weeks, and A. Assur.
Report available from Office of Naval Research, Dept of Navy, Wash, DC. Cold Regions Research and Engineering Laboratory Research Report 269, Sept 1969. 79 p, 57 fig, 1 tab, 174 ref.

Descriptors: *Ice, *Lake ice, *Ice breakup, *Bibliographies, *Reviews, Surveys, Rivers, Melting, Iced lakes, Ice jams, Mechanical properties, Water chemistry, Navigation, Sea ice.
Identifiers: Ice cracks, Fracturing (Ice), Pack ice, Ice navigation, Icebreakers (Ships).

A survey of literature on the structure of ice I and the macro- microstructure of sea and lake ice includes ice chemistry and phase relations. Recent work on the direct observation of dislocations as well as the formation of cracks in ice is summarized. Formal ice-brine-air models for analyzing variations in ice strength are also reviewed. The results of the different types of tests are discussed and compared (compressive, indentation, direct and ring-tension, small beam flexure and in situ cantilevers and simple beams, shear, and impact). Scale effects are considered as well as the rapid strength deterioration experienced by ice sheets in the spring. Finally, a number of recommendations are made concerning future research in this field. (Knapp-USGS)
W70-03651

SNOW ALBEDO MODIFICATION - A REVIEW OF LITERATURE,
Army Terrestrial Sciences Center, Hanover, N.H.
Charles W. Slaughter.
Cold Regions Research and Engineering Laboratory Technical Report 217, Oct 1969. 25 p, 4 fig, 10 tab, 113 ref. DA Task 1T061102B52A02.

Descriptors: *Albedo, *Snow, *Melting, Heat budget, Melting, Water management (Applied), Water yield, Water yield improvement, Snowpacks.
Identifiers: *Albedo modification.

A summary of published information on snow albedo modification is presented. Consideration of energy balance parameters includes discussion of qualitative and quantitative results of albedo modification. Practical applications of albedo modification are discussed. Snowmelt retardation methods are discussed as related to reducing soil erosion and the occurrence of flash floods from glacier meltwater. Such methods as spreading dry sand, sawdust, various debris, and the use of dense smoke from burning of leaves, straw, peat, and other material to reduce the rate of melting are cited. (Knapp-USGS)
W70-03652

METHODS FOR THE DETERMINATION OF MAXIMUM SNOW RESERVES IN THE RIVER BASINS OF THE CENTRAL CHERNOZEM (BLACK EARTH) BELT (RUSSIAN),
State Hydrological Inst., Leningrad (USSR).
B. L. Sokolov.
In: Sbornik Rabot po Gidrologii (Collection of Works on Hydrology), Gosudarstvennyi Gidrologicheskii Institute, Leningrad, Issue No 8, p 37-46, 1968. 10 p, 3 fig, 1 tab, 15 ref.

Descriptors: *Snow, *Snowmelt, *River basins, *Chernozems, *Snow cover, Precipitation (Atmospheric), Ice, Water supply, Maps, Forests, Land, Forecasting, Mathematical studies, Gaging stations, Frequency, Evaporation, Runoff.
Identifiers: *USSR, Central chernozem belt.

Snow reserves in the chernozem belt basins of USSR were investigated on the basis of hydrologic data recorded at 300 gaging stations and observation points. A table shows the frequencies of maximum snow resources and maps of snow accumulation in the ravines and forest areas. (Gabriel-USGS)
W70-03684

THE USE OF RADIOACTIVE TRACER GASES TO STUDY THE RATE OF EXCHANGE OF WATER VAPOR BETWEEN AIR AND NATURAL SURFACES,
Atomic Energy of Canada Ltd., Chalk River (Ontario). Environmental Research Branch.
P. J. Barry.
In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 69-76, 1967. 8 p, 3 fig, 3 tab, 9 ref.

Descriptors: *Radioisotopes, *Radioactivity techniques, *Water vapor, *Tritium, Tracers, Iodine radioisotopes, Snow, Diffusivity, Diffusion, Turbulent flow, Mass transfer, Evaporation.
Identifiers: Water vapor exchange rates.

Radioactive hydrogen (tritium) as a mixed oxide with hydrogen (tritiated water or HTO) and idodine 131 have been used to measure the flux of matter at the surface of snow. The snow surface was selected because: (1) it is among the simplest of natural surfaces; (2) it is free of vegetation effects; (3) it occurs in a wide range of surface textures and roughness; (4) it is frequently renewed; and (5) an accurate sample can be collected and the radioactive tracers may be collected by melting. By using the two tracers with markedly different molecular diffusivities it was possible to study the turbulent and molecular movements separately. Comparison of experimental data with equations for calculating mass transfer rates from surface-to-air gradients showed that no existing equation predicted rates of evaporation satisfactorily. (Carstea-USGS)
W70-03695

EROSION OF CIRQUES,
North Carolina Univ., Chapel Hill. Dept. of Geology.
For primary bibliographic entry see Field 02J.
W70-03846

WEATHER AND DIURNAL FROZEN SOIL STRUCTURE AT CHARLOTTESVILLE, VIRGINIA,
Virginia Univ., Charlottesville.
Sam I. Outcalt.
Water Resources Research, Vol 5, No 6, p 1377-1382, Dec 1969. 6 p, 3 fig, 3 tab, 9 ref.

Descriptors: *Frost, *Weather, Virginia, Freezing, Frozen soils, Ice, Soil water movement, Soil moisture, Soil structure, Statistical methods.
Identifiers: Soil water freezing, Frozen soil structure.

The results of a field study of weather conditions and diurnal frost structures demonstrate the effect of the atmospheric environment on the structure of soils at a site where soil water content was not a limiting factor. Statistical discrimination of soil freezing and frozen soil structures is often made possible by using late afternoon sky and dew-point temperature data. An evolutionary classification of three typical frozen soil structures is also presented. (Knapp-USGS)
W70-03863

2D. Evaporation and Transpiration

POTENTIAL EVAPORATION AS A MANIFESTATION OF REGIONAL EVAPORATION,
Department of Energy, Mines, and Resources, Ottawa (Ontario). Hydrologic Sciences Div.
F. I. Morton.
Water Resources Research, Vol 5, No 6, p 1244-1255, Dec 1969. 12 p, 5 fig, 2 tab, 14 ref.

Descriptors: *Evaporation, *Mathematical models, Energy budget, Heat balance, Water balance, Mass transfer, Meteoric water, Meteorology, Microenvironment, Saturation, Solar radiation, Temperature, Vapor pressure, Water loss, Evaporators, Humidity, Evapotranspiration.
Identifiers: Potential evaporation.

The temperature and humidity of the lower atmosphere are treated as causes of evaporation from a small continuously moist area and as effects of evaporation from a large area with variable moisture supply. This leads to the formulation of a model in which the sum of the regional and potential evaporation is equal to the evaporation equivalent of the absorbed insolation. Such a formulation permits the regional evaporation, a product of climatic, soil moisture, and vegetation processes, to be estimated by its effects on climatologic or evaporimeter observations. Test data are derived from class A evaporation pan observations from the near-arid regions of the southwestern United States, and the near-humid regions of Ireland and from records of rainfall and runoff for Irish river catchments. Comparisons with the model predictions provide good evidence for the validity of the model and interesting insights into its hydrologic and climatologic implications. (Knapp-USGS)
W70-03676

EVAPORATION FROM LARGE DEEP LAKES,
Department of Energy, Mines and Resources, Cornwall (Ontario). Great Lakes-St. Lawrence Study Office.
F. I. Morton.
Water Resources Research, Vol 3, No 1, p 181-200, Jan 1967. 6 fig, 10 tab, 9 ref.

Descriptors: *Energy budget, *Evaporation, *Lakes, Lake Superior, Lake Ontario, Hydrology, Limnology.

entifiers: Water budget, Transitional zone, Deep kes, Shallow lakes.

erived insolation and water budget evaporation ata for Lake Superior and Lake Ontario are nalyzed in terms of both the regional and the ater surface energy balances. The results indicate at the seasonal pattern of evaporation is overned by heat storage changes, and that these hanges are closely associated with atmospheric nergy export from the lake. This finding provides physical basis for the simple empirical relationips between monthly evaporation and island-to-ainland temperature differentials that are eveloped from the water budget evaporation data. ubstantial atmospheric energy export, a concomiant of heat storage changes, reduces the energy vailable for evaporation. Therefore, evaporation rom a large deep lake is less than that from a large hallow lake under comparable climatic conditions. he analysis also provides speculative reasoning nd evidence to indicate that evaporation from a arge deep lake is closely related to the radiant heat ransfer to the sky. (Rietveld-Vanderbilt)
W70-03717

STOCHASTIC ASPECTS OF LAKE ONTARIO EVAPORATION,
Rutgers - The State Univ., New Brunswick, N.J.; and Cornell Univ., Ithaca, N.Y.
L. Yu Shaw, and Wilfried Brutsaert.
Water Resources Research, Vol 5, No 6, p 1256-1266, Dec 1969. 11 p, 7 fig, 5 tab, 13 ref. OWRR Project A-021-NY.

Descriptors: *Evaporation, *Lake Ontario, *Stochastic processes, Markov processes, Time series analysis, Correlation analysis, Winds, Temperature, Humidity, Energy budget, Heat balance, Water balance, Statistical models, Model studies.
Identifiers: Spectral analysis, Cross-spectral analysis.

Time series analysis was carried out on long-term monthly mean values of evaporation from Lake Ontario, which were generated in an earlier study, and on related meteorologic parameters. Correlation and spectral analyses showed that the annual cycle was dominant in all the time series. Evaporation is usually high in autumn and winter and low in spring and summer. A warming trend was observed in the air temperature and a drying trend in the relative humidity series. Except for the wind speed, no significant trend was found for the other time series. Cross correlation and cross-spectral analyses showed a close relationship between evaporation anomalies and the anomalies of the other parameters. A first order Markov model adequately described the evaporation, air temperature, and relative humidity anomalies, whereas a second order model fitted the anomalies of wind speed and water surface temperature. Morton's (1967) water budget method yields higher evaporation estimates in the summer and lower estimates in the winter than the mass transfer estimates. (Knapp-USGS)
W70-03872

RELATIONSHIPS BETWEEN SOIL MOISTURE ACTUAL AND POTENTIAL EVAPOTRANSPIRATION,
Department of Agriculture, Ottawa (Ontario). Plant Research Inst.
W. Baier.
Proceedings of Hydrology Symposium No 6 on Soil Moisture, Saskatchewan University, Nov 15-16, 1967, p 155-204, National Research Council, Ottawa, Canada, 1968. 50 p, 5 fig, 4 tab, 115 ref.

Descriptors: *Evapotranspiration, *Soil water movement, *Soil moisture, Soil types, Vegetation, Analytical techniques, Climatic data, Water balance, Energy budget, Solar radiation.
Identifiers: Actual evapotranspiration, Potential evapotranspiration.

Under natural conditions, actual evapotranspiration (AE) primarily depends on the available energy - or the atmospheric demand as reflected in the potential evapotranspiration (PE) - and the availability of soil moisture. The progress made during recent years in determining AE and PE is critically reviewed. Concepts of the relationships between PE, AE and available soil moisture for different types of soil and vegetation and for various atmospheric demand rates are examined. Emphasis is on present techniques for estimating short-term variations of PE, AE and soil moisture from readily available climatological data. Examples are given for the application of such soil moisture estimates from meteorological budgets in water balance studies and agroclimatic analysis of an area. (Carstea-USGS)
W70-03885

ABOUT THE ANALYTICAL METHOD FOR THE COMPILATION OF THE WATER BALANCE IN AGRICULTURE,
Palermo Univ. (Italy). Istituto di Idraulica.
Ignazio Melisenda.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 82, p 659-671, 1967. 13 p, 3 fig, 4 tab, 3 ref.

Descriptors: *Hydrologic budget, *Hydrologic data, *Data processing, *Statistical methods, Regression analysis, Evapotranspiration, Rainfall, Runoff, Water balance, Farm management.
Identifiers: Water budget computation.

Actual and potential evapotranspiration are compared and 2 numerical analyses are developed to define quantitatively their relation in 6 hydrographical basins typical of Sicily. The first analysis concerns the spreads among the annual values of evapotranspiration corresponding to the annual values of potential evapotranspiration determined for the same climatic-pedological and agricultural surroundings by means of the various formulas in use. The second analysis concerns the spreads obtained among the values of potential evapotranspiration for the dry season calculated by the application of drying process laws of different form. (Knapp-USGS)
W70-03901

2E. Streamflow and Runoff

FLOOD PLAIN INFORMATION, ROSILLO CREEK, BEXAR COUNTY, TEXAS.
Corps of Engineers, Fort Worth, Tex.
For primary bibliographic entry see Field 04A.
W70-03647

DETERMINATION OF OPTIMAL FLOOD PROTECTION LEVELS WITH SMALL EXCEEDANCE PROBABILITIES,
Carnegie-Mellon Univ., Pittsburgh, Pa.
For primary bibliographic entry see Field 06A.
W70-03653

USE OF THE CRITICAL PERIOD IN RESERVOIR ANALYSIS,
California Univ., Los Angeles.
For primary bibliographic entry see Field 04A.
W70-03655

CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO AREAL INVESTIGATIONS AND MISCELLANEOUS ACTIVITIES,
Geological Survey, Washington, D.C. Office of Water Data Coordination.
W. W. Doyel, W. F. Curtis, and E. B. Chase.
Report available at no cost from OWDC, US Geological Survey, Wash, DC, 20242. Geological Survey Water Data Catalog, 1969. 161 p, 2 exhib, 3 tab.

Descriptors: *Data collections, *Hydrologic data, *Documentation, *Surveys, *Data storage and retrieval, Networks, Monitoring, Sampling, Instrumentation, Stations, Libraries, Investigations.
Identifiers: *Catalog of Information on Water Data.

An index is presented for use in retrieving areal investigation and miscellaneous activity data from the Catalog of Information on Water Data, a record of activities in water data collection in the U.S. The Catalog is a file of information that is accessible through data-retrieval procedures--it contains information about water-data acquisition activities but does not contain the actual data, which must be obtained from the reporting agencies. Input to the Catalog consists of information supplied by Federal, State, and local agencies that acquire water data directly in the field and laboratory. All information is stored on media suitable for data processing, supplemented by microforms and maps. Information from the Catalog (output) is made available through indexes such as this publication, which is the index to the areal investigations and miscellaneous activities section of the Catalog. The indexes help the water-data user determine the data that are available for an area and also the data available from an agency. The indexes to the 'Catalog of Information on Water Data' are indexes to separate sections of the Catalog. These indexes are designed to help the user determine what data are available that might serve his needs. (Knapp-USGS)
W70-03663

FLOOD PLAIN INFORMATION, ARKANSAS RIVER, DODGE CITY, KANSAS.
Corps of Engineers, Albuquerque, N. Mex.
For primary bibliographic entry see Field 04A.
W70-03668

GEOLOGY AND GROUNDWATER RESOURCES OF OCEAN COUNTY, NEW JERSEY,
Geological Survey, Trenton, N.J.
For primary bibliographic entry see Field 02F.
W70-03670

ESTIMATION OF THE PARAMETERS OF GUMBEL'S THIRD ASYMPTOTIC DISTRIBUTION BY DIFFERENT METHODS,
Michigan Univ., Ann Arbor; and Georgia Inst. of Tech., Atlanta.
For primary bibliographic entry see Field 07C.
W70-03674

REDUCTION OF ANNUAL RIVER FLOWS TO LONGER PERIODS (RUSSIAN),
State Hydrological Inst., Leningrad (USSR).
A. V. Rozhdestvenskiy.
In: Sbornik Rabot po Gidrologii (Collection of Works on Hydrology), Gosudarstvennyi Gidrologicheskii Institute, Leningrad, Issue No 8, p 3-13, 1968. 11 p, 3 fig, 3 tab, 4 ref.

Descriptors: *River flow, *Mathematical studies, *Analytical techniques, *Discharge (Water), Monte Carlo method, Stochastic processes, Fluctuation, Mathematical models, Gaging stations, Discharge coefficients, Water level fluctuations, Correlation analysis.
Identifiers: *USSR, Neva River, Leningrad region, Tikhvinka River.

Flow discharges of the Neva River and Tikhvinka River, recorded in 1924-1953 and 1881-1953, respectively, were analyzed by using a cyclic oscillation method and the Monte Carlo method. Basically, the reduction of annual river discharges to a longer period is accomplished by separating the annual discharges into dynamical norms and random variations and by introducing a method of successive differences. Comparison of correlation functions, river discharge norms, and variation coefficients, derived by using initial and modulated series, indicates the reliability of the described mathematical method for the analysis of a series of

annual discharges. The reliability of the determination of a discharge dynamic norm, however, is determined by a degree of association of drainage dynamic norms of two gaging stations and their temporal stability. (Gabriel-USGS)
W70-03681

CALCULATION OF MAXIMUM DISCHARGES OF CRIMEAN RIVERS (RUSSIAN),
Kiev Hydrometeorological Observatory (USSR).
Ye. V. Khloyeva.
In: Sbornik Rabot po Gidrologii (Collection of Works on Hydrology), Gosudarstvennyi Gidrologicheskii Institute, Leningrad, Issue No 8, p 14-26, 1968. 13 p, 6 fig, 2 tab, 17 ref.

Descriptors: *Discharge (Water), *River basins, *Mathematical studies, Frequency, Floods, Gaging stations, Hydrologic properties, Watersheds (Basins), Precipitation (Atmospheric), Karst, Reservoirs.
Identifiers: *USSR, Crimean Rivers.

Because the hydrologic regimes of rivers play an important part in the selection of suitable hydrologic structures and country roads, the maximum discharges of Crimean rivers were analyzed. The Alekseyev analytical formula, modified by the author, gives the values of maximum discharges. As a function of drainage area, tributary discharge values, regulated flow coefficient, reduction index, and flow attenuation parameter. As a result of this study two empirical formulas were developed, one for mountainous areas and the other for karstic areas. (Gabriel-USGS)
W70-03682

RUNOFF VOLUME AND MAXIMUM DISCHARGES OF SPRING FLOODS APPLIED TO THE UNSTUDIED RIVERS OF KALININGRADSK REGION (RUSSIAN),
State Inst. for Planning Reservoir and Land Improvement Constructions, Leningrad (USSR).
R. Ya. Narodetskaya.
In: Sbornik Rabot po Gidrologii (Collection of Works on Hydrology), Gosudarstvennyi Gidrologicheskii Institute, Leningrad, Issue No 8, p 27-36, 1968. 10 p, 2 fig, 1 tab, 6 ref.

Descriptors: *River flow, *Discharge (Water), *Floods, *River basins, *Analytical techniques, Hydrologic aspects, Watersheds (Basins), Vegetation, Groundwater, Geology, Humidity, Dams, Snow, Precipitation (Atmospheric), Snowmelt, Frequency.
Identifiers: *USSR, Kaliningradsk region.

The hydrologic regimes of the Kaliningradsk rivers, USSR, were investigated on the basis of maximum spring flood discharge and rainfall flood data. Spring water discharges of the majority of the rivers in Kaliningradsk region exceed the rainfall flood discharges. In general, the maps of the distribution of flood-discharge simplify the evaluation of hydrologic characteristics of unstudied rivers. (Gabriel-USGS)
W70-03683

THE DETERMINATION OF LOCAL INFLOWS ENTERING A CHANNEL,
Maryland Univ., College Park.
Robert M. Ragan.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 31, p 235-243, 1967. 9 p, 5 fig, 4 ref.

Descriptors: *Routing, *Overland flow, *Hydraulic models, *Mathematical models, *Open channel flow, Numerical analysis, Synthetic hydrology, Rainfall-runoff relationships, Streamflow forecasting, Runoff forecasting.
Identifiers: *Lateral inflows.

Many recent studies have been devoted to the development of numerical solutions of the partial differential equations of free surface flow as flood routing tools. When proper measurements are made in the stream during a period of runoff, the numerical methods may also be used to compute the time and spatial distributions of the local runoff entering along the length of the channel. The advantage of the technique is that it provides a logical means of isolating land phase hydrographs for detailed study. A discussion of the approach is given and numerically generated local inflow hydrographs are compared with the lateral inflows entering along the length of a laboratory flume. The comparison showed that the approach is feasible and, in general, good agreement with the experimental data was obtained. A discussion of the sensitivities indicated by the numerical-experimental comparison is also presented. (Knapp-USGS)
W70-03699

AN ERROR MODEL FOR A SINGLE DISCHARGE MEASUREMENT,
Ontario Agricultural Coll., Guelph. School of Agricultural Engineering.
W. T. Dickinson.
French resume included. Proceeding of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 32, p 244-251, 1967. 8 p, 1 fig, 1 tab, 3 ref. Bureau of Reclamation Contract No 14-06-D-5299.

Descriptors: *Discharge (Water), *Streamflow, *Discharge measurement, *Evaluation, *Statistical methods, Theoretical analysis, Stream gages, Gaging stations, Stage-discharge relations.
Identifiers: *Error analysis.

A hypothetical error model is developed for a single stream discharge measurement. The qualitative interrelationships of various component errors, and the nature of some of these errors are investigated. In particular, the robustness of sampling techniques for vertical velocity distributions, the sampling of velocity in time, and the effect of oblique currents on current-meter response are considered. Expressions are presented for the bias and the variance of a single discharge measurement in terms of the expected values and variance of the component errors. (Knapp-USGS)
W70-03700

A PROPERTY OF THE RANGE OF PARTIAL SUMS,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07A.
W70-03701

STOCHASTIC STUDY OF CHANNEL DISTRIBUTION IN RIVER BASINS,
Kyoto Univ. (Japan). Dept. of Civil Engineering.
Tojiro Ishihara, Yoshiaki Iwasa, and Takuma Takasao.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 47, p 361-369, 1967. 9 p, 4 fig.

Descriptors: *River basins, *Channels, *Stochastic processes, *Geomorphology, Channel morphology, Statistical models, Networks, Probability, Distribution patterns, Shape, Drainage density.
Identifiers: Drainage basin morphology.

The geometric structure of channel distribution in a river basin is a basic characteristic for the mathematical analysis of flood runoff as intensive hydrologic phenomena and for the quantitative evaluation of long range variations in configuration of river basin and runoff pattern. The stochastic process of the formation of channel distribution in a river basin under the action of external agency is analyzed by a model constructed in terms of the concept of order in quantitative geomorphology, the theory of geometric network, and the probabilistic approach. The mathematical analysis discloses the probabilistic characteristics of geometric quantities composing the channel distribution, and it is concluded that the channel distribution converges to three statistical laws under the equilibrium condition. (Knapp-USGS)
W70-03707

STATISTICAL CONSIDERATION IN RIVER MORPHOLOGY,
Institute for Water Resources, Belgrade (Yugoslavia).
Stevan Bruk, and Miodrag Bozinovic.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 48, p 370-375, 1967. 6 p, 6 fig, 2 ref.

Descriptors: *River basins, *Channels, *Stochastic processes, *Geomorphology, *Channel morphology, Statistical models, Networks, Probability, Distribution patterns, Shape, Drainage density, Sediment transport, Bed load, Alluvial channels, Meanders.
Identifiers: River basin morphology, Ergodic processes, Morava River (Yugoslavia).

The development of alluvial rivers may be considered as a stochastic process, the channel geometry being a random function of position and time. Consequently, statistical techniques must be used in the description of bed morphology, defining the channel geometry and other values by means of distribution functions and statistical moments. Autocorrelation analysis of the channel geometry leads to characteristic lengths by which the meandering can be statistically described. Admitting that the development of an alluvial bed is an ergodic and stationary process, time averages and distribution functions can be replaced by space averages and distribution functions (taken along the river), by which long term predictions of values like the average bed-load transport can be made with success. The example given refers to the Morava River in Yugoslavia. (Knapp-USGS)
W70-03708

ADAPTIVE FILTERS FOR TREND EXTRAPOLATION OF RUNOFF RECORDS,
Deutsche Akademie der Wissenschaften zu Berlin (East Germany). Inst. for Physical Hydrography.
For primary bibliographic entry see Field 07C.
W70-03710

UNIFIED VIEW OF DIFFUSION AND DISPERSION,
Illinois Univ., Urbana. Dept. of Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-03729

MOTION OF TWO DIMENSIONAL STARTING PLUME,
Waterloo Univ. (Ontario). Dept. of Mechanical Engineering; and New South Wales Univ., Kensington (Australia).
For primary bibliographic entry see Field 08B.
W70-03731

LABORATORY TESTS OF SPRAYABLE MATERIALS FOR RUNOFF INDUCEMENT ON A LOESSIAL SOIL,
Hebrew Univ., Jerusalem (Israel). Faculty of Agriculture; and National Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculure Research.
D. Hillel, A. Schwartz, R. Steinhardt, and E. Rawitz.
Israel Journal of Agricultural Research, Vol 19, No 1, p 3-9, Jan 1969. 1 tab, 2 fig, 7 ref.

Descriptors: *Arid lands, *Waterproofing, *Water harvesting, *Surface runoff, *Soil treatment, Infiltration, Soil structure, Surface sealing, Laboratory tests, Asphalt, Rainfall simulators, Surface sealing, Soil sealants, Emulsions, Rates of application.
Identifiers: *Israel, Fuel oil, Latex, Wax.

is is one of a series of reports by Hillel and col-gues on studies conducted to determine effec-e means of increasing runoff from slopes to nted areas. The work was conducted in arid ael. This paper reports results of laboratory trials 4 chemical treatments intended to seal or water-of the soil surface to increase the runoff-rainfall io. Light fuel oil, latex, asphalt and wax were ted on soil-filled runoff boxes using a rainfall ulator. The treatments were found to produce 3 ects: hydrophobic, structure stabilizing and sur-e sealing. Low application rates tended to stabil-structure, but at higher applications, the sealing ect occurred and the runoff ratio was greatly in-ased. Fuel oil appeared to be the most efficient terial for achieving the desired runoff increases. rouse-Arizona)
70-03804

THE EXTREME VALUE DISTRIBUTION R DESCRIBING ANNUAL FLOOD SERIES,
w South Wales Univ., Kensington (Australia).
H. Huxham, and C. A. McGilchrist.
ater Resources Research, Vol 5, No 6, p 1404-05, Dec 1969. 2 p, 1 fig, 9 ref.

scriptors: *Floods, *Frequency analysis, robability, Statistical methods, Forecasting, od forecasting.
ntifiers: Extreme value analysis.

me criticisms concerning the use of the extreme ue distribution for annual flood series are con-ered. The extreme value distribution can now be ed easily and efficiently to extreme data. hough the theoretical extreme value distribution nly an asymptotic result, for moderate sample es an extreme value distribution with parameters ferent from the theoretical ones is often a good to the data. (Knapp-USGS)
70-03854

PEAK DISCHARGE RELATION FOR INTER-EDIATE DRAINAGE BASINS,
een's Univ., Kingston (Ontario).
E. Watt, and R. J. Kennedy.
ater Resources Research, Vol 5, No 6, p 1406-09, Dec 1969. 4 p, 4 fig, 4 ref.

scriptors: *Peak discharge, *Flood forecasting, robability, Streamflow forecasting, Statistical thods, Frequency analysis, Routing.
ntifiers: Intermediate drainage basins, Ontario anada).

r ungaged drainage basins of intermediate size, a ak discharge-frequency relation may be deter-ned from a frequency distribution of rainfall ex-ss and a method for relating peak discharge to nfall excess. For short-period hydrographs a e-parameter peak discharge relation employing basin lag is satisfactory. Analysis of the records 45 isolated intense storms on 12 drainage basins southern Ontario provided satisfactory confir-tion of the above relation. (Knapp-USGS)
70-03855

TEN-UNIT WATER LEVEL SENSING AND CORDING SYSTEM,
ryland Univ., College Park.
r primary bibliographic entry see Field 07B.
70-03857

TIMATION OF STATISTICAL PARAME-RS FOR ANNUAL RIVER FLOWS,
iversidad Nacional del Zulia, Maracaibo enezuela).
acio Rodriguez-Iturbe.
ater Resources Research, Vol 5, No 6, p 1418-21, Dec 1969. 4 p, 1 fig, 2 tab, 9 ref.

scriptors: *Streamflow forecasting, *Statistical dels, Statistical methods, Markov processes, mpling, Correlation analysis, Time series analy-

ntifiers: Annual river flow series.

A first order Markov process is chosen as representative for annual river flows. The normalized standard errors of the estimates of the mean, the variance, and the first autocorrelation coefficient are shown as functions of the sample size for a river which is considered to have average statistical characteristics. The theoretical analysis is complemented with a study of the variations with sample size of the main statistical parameters of three rivers with a large amount of data. On the average between 40 and 60 years of data are desirable to estimate the mean and the variance. The normalized standard error grows rapidly with any diminishing of the sample size. Beyond this range the normalized standard error of estimate decreases slowly with lengthening sample size. Large errors appear to be common in estimating the first autocorrelation coefficient, even for series whose length is much longer than is normally found. (Knapp-USGS)
W70-03858

COMPARISON OF SMART AND SCHEIDEGGER STREAM LENGTH MODELS,
IBM Watson Research Center, Yorktown Heights, N.Y.
J. S. Smart.
Water Resources Research, Vol 5, No 6, p 1383-1387, Dec 1969. 5 p, 1 tab, 11 ref.

Descriptors: *Drainage patterns (Geologic), *Statistical models, Drainage density, Networks, Tributaries, Statistical methods, Geomorphology, Channel morphology.
Identifiers: *Stream length models, Stream order.

The Smart and Scheidegger stream length models are compared and shown to have similar concepts. Discrepancies in the general conclusions reached by the two authors arise from different methods of developing the models and of making comparisons with observation. The results of analysis of Scheidegger's procedures and the results of tests designed to avoid some of the difficulties encountered there fail to lend any support to the suggestion that interior link lengths increase with stream order. (Knapp-USGS)
W70-03862

CONSTRAINED RANDOM WALK MEANDER GENERATION,
IBM Watson Research Center, Yorktown Heights, N.Y.
Alvin J. Surkan, and Joseph Van Kan.
Water Resources Research, Vol 5, No 6, p 1343-1352, Dec 1969. 10 p, 11 fig, 2 tab, 9 ref.

Descriptors: *Drainage patterns (Geologic), *Statistical models, *Meanders, *Stream erosion, Sediment transport, Statistical methods, Monte Carlo method, Stochastic processes, Markov processes.
Identifiers: *Random-walk models.

Analyses of meander data and comparison of models based on von Schelling's theory of random walks for isotropic Gaussian deviations yield constraints satisfactory for simulation of realistic meander paths. Runge-Kutta solutions of the differential equation for most probable paths exhibit excessive regularity. Calculation of correlation functions, transition probability matrices, and second moments for natural meander data as a function of segment direction reveals important dependency on segment ordering and shows isotropic random walk models to be untenable. Neither the directions, curvatures, nor their changes in natural meanders are Gaussian independent. Necessary constraints on random walk deviations for simulating meanders include a significant positive correlation for adjacent curvatures and directions and often a negative one between the curvature changes. Both result from azimuth dependence in the second moment of the curvature. The application of a directional property of meander curvatures makes possible (1) simulation of realistic meander paths, (2) statistical determination of flow direction, and (3) numerical evidence of a unidirectional flow origin for any meander-like path. (Knapp-USGS)
W70-03866

A WORKING MODEL FOR THE VARIATION IN STREAM WATER CHEMISTRY AT THE HUBBARD BROOK EXPERIMENTAL FOREST, NEW HAMPSHIRE,
Dartmouth Coll., Hanover, N.H.; Yale Univ., New Haven, Conn.; Geological Survey, Washington, D.C.; and Forest Service (USDA), Durham, N.H.
For primary bibliographic entry see Field 02K.
W70-03867

FLOOD PLAIN INFORMATION, LOOKING-GLASS RIVER, CLINTON COUNTY, MICHIGAN.
Corps of Engineers, Detroit, Mich.
For primary bibliographic entry see Field 04A.
W70-03868

DISTRIBUTION OF INTERIOR LINK LENGTHS IN NATURAL CHANNEL NETWORKS,
IBM Watson Research Center, Yorktown Heights, N.Y.
J. S. Smart.
Water Resources Research, Vol 5, No 6, p 1337-1342, Dec 1969. 6 p, 2 fig, 3 tab, 13 ref.

Descriptors: *Drainage patterns (Geologic), *Statistical models, Drainage density, Tributaries, Statistical methods, Geomorphology, Channel morphology.
Identifiers: Nonparametric statistics.

Interior link lengths were measured for 10 channel networks with magnitudes between 80 and 200. Nonparametric statistical methods were used to test the hypothesis that link length is independent of link magnitude. Four of the networks show no significant change (5% level) of link length with magnitude. Some of the other networks do have significant changes in link length, but the exact number depends on the nature of the alternative hypothesis. Half of the observed changes were positive and half were negative. (Knapp-USGS)
W70-03878

PURPOSE AND PERFORMANCE OF PEAK PREDICTIONS,
Pennsylvania State Univ., University Park, Pa. Dept. of Civil Engineering; and Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 04A.
W70-03887

DISCRIMINATING THE CHANGE IN MEANS OF HYDROLOGIC VARIABLES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 04A.
W70-03888

TRENT BASIN STOCHASTICS,
Manchester Univ. (England). Dept. of Engineering.
Harmindar S. Takhar.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 81, p 648-658, 1967. 11 p, 2 fig, 1 tab.

Descriptors: *Streamflow, *Stochastic processes, Statistical methods, Statistical models, Stream gages, Data collections, Hydrologic data.
Identifiers: *England, *River Trent.

The River Trent is one of the main British rivers. The actual headwaters rise on the springs of the Millstone Grit deposits of the Upper Carboniferous System of rocks at an approximate height of 926 feet above sea level. The total length of the River

Trent from the highest headwater stream to the Trent Falls is 173.20 miles draining a total of Non-Tidal area of 3178.68 square miles through different conurbations and morphological situations. A quantitative study of some simple statistical parameters derived from the daily mean flows of the entire Trent basin is made. Qualitative inferences are drawn from these statistical parameters about the nature of the flows to be expected. Spatial and temporal variations of these parameters are shown to reflect in the corresponding behaviors of the river flows. Arguments are also initiated to relate the significance of the simple river stochastics to the existing geology of the basin. (Knapp-USGS)
W70-03902

GENERALIZED DROUGHT SEQUENCE PROBABILITIES FOR STORAGE-DRAFT-FREQUENCY ANALYSIS,
University of the Witwatersrand, Johannesburg (South Africa). Dept. of Hydraulic Engineering.
Desmond C. Midgley.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 57, p 443-450, 1967. 8 p, 2 fig, 8 ref.

Descriptors: *Streamflow forecasting, *Statistical methods, *Mass curves, Probability, Equations, Duration curves, Hydrographs, Rainfall-runoff relationships, Stage-discharge relations, Stream gages, Networks, Data collections, Water storage.
Identifiers: Stream gaging.

Independent deficient flow sequences of increasing duration, abstracted from the streamflow data of rivers having relatively long records, were subjected to extreme value analysis (Gumbel). The ordinates of the resulting families of annual mass curves, having recurrence interval as parameter, were rendered dimensionless by dividing by mean annual riverflow and were then generalized on a regional basis. An empirical equation was developed to describe the resulting families of critical mass curves and the characteristic constants of the equation were evaluated for several regions of South Africa. (Knapp-USGS)
W70-03904

A PRINCIPAL COMPONENT ANALYSIS OF SURFACE RUNOFF DATA FROM A NEW ZEALAND ALPINE WATERSHED,
Harvard Univ., Cambridge, Mass. Dept. of Engineering and Applied Physics.
Leo M. Eiselstein.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 61, p 479-489, 1967. 11 p, 7 tab, 15 ref.

Descriptors: *Rainfall-runoff relationships, *Statistical methods, *Unit hydrographs, *Correlation analysis, Small watersheds, Antecedent precipitation, Infiltration, Evapotranspiration, Regression analysis, Synthetic hydrology, Statistical models.
Identifiers: *New Zealand, Principal component analysis.

The analysis of surface runoff data from small watersheds by principal component analysis with varimax rotation of the factor weight matrix is discussed. An example of principal component regression analysis applied to surface runoff data from an experimental watershed near Christchurch, New Zealand is presented. It is suggested that this analysis method would be suitable for correlating the surface characteristics of a small watershed with the parameters of a unit hydrograph model. Principal component regression analysis with varimax rotation of the factor weight matrix could therefore be used for the 'synthesis' of flow records for ungaged small watersheds. (Knapp-USGS)
W70-03908

APPLICATION OF RUNS TO HYDROLOGIC DROUGHTS,
Vermont Univ., Burlington. Dept. of Civil Engineering; and Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
Richard N. Downer, M. M. Siddiqui, and V. Yevjevich.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 63, p 496-505, 1967. 10 p, 4 fig, 1 tab, 1 ref.

Descriptors: *Droughts, *Streamflow forecasting, *Rainfall-runoff relationships, *Time series analysis, Stochastic processes, Probability, Statistical methods, Statistical models, Synthetic hydrology.
Identifiers: Drought statistics, Statistical runs.

On the basis of the theory of runs, an objective definition of hydrologic drought is set forth. The definition takes into account both the duration and magnitude of the drought. Two concepts are outlined: that of the run-length, which indicates the duration of the drought; and that of run-sum, which indicates the magnitude of the drought. Once the reference value or the probability of the reference value for the drought has been selected, the definition can be objectively applied to any time series. Equations of the properties of run-length and run-sum are derived analytically for independent random variables and applied to the independent normal standard variable. The data generation method was used on the independent normal standard variable to check the analytical solutions. The comparison indicated that the data generation method was satisfactory, and it was then applied to the independent standard log-normal variable with various skewnesses to derive its properties of runs. (Knapp-USGS)
W70-03909

EFFECTS OF SAMPLING INTERVAL, PERIODICITY, DEPENDENCE AND SKEWNESS ON EXTREME VALUES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
David F. Kibler, and Vujica Yevjevich.
French resume included. Research sponsored by National Science Foundation. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 67, p 537-545, 1967. 9 p, 11 fig, 3 ref. NSF Grant GK-169.

Descriptors: *Streamflow forecasting, *Flood forecasting, *Statistical methods, *Probability, Sampling, Hydrographs, Duration curves, Mass curves, Time series analysis, Stochastic processes, Synthetic hydrology.
Identifiers: Extreme value theory.

In order to test the validity of extreme value theory as applied to hydrologic extremes, a study has been made of the effects of sampling interval (in which the extreme value is selected), periodicity, dependence, and skewness on the frequency distributions of extreme values. A standard normal initial distribution is first obtained by data generation techniques. Periodicity, dependence, and skewness are superimposed on the initial standard normal distribution. The Gumbel double-exponential distribution curve is then fitted to the generated extremes and distribution parameters, and dispersion index and mode are computed. Results are presented as a series of graphical plots which illustrate the distribution parameters as they vary with changing sampling intervals, harmonic amplitude, sequential dependence, and skewness in the initial distributions. (Knapp-USGS)
W70-03910

2F. Groundwater

STATISTICAL EVALUATION OF SALINITY AND NITRATE CONTENT AND TRENDS BENEATH URBAN AND AGRICULTURAL AREA-FRESNO, CALIFORNIA,
Agricultural Research Service, Fresno, Calif. Groundwater Recharge Field Station.
For primary bibliographic entry see Field 05B.
W70-03649

CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO GROUNDWATER STATIONS,
Geological Survey, Washington, D.C. Office of Water Data Coordination.
J. R. Rapp, W. W. Doyel, and E. B. Chase.
Report available at no cost from OWDC, US Geological Survey, Wash, DC, 20242. Geological Survey Water Data Catalog, 1969. 657 p, 1 fig, 1 exhib, 4 tab.

Descriptors: *Data collections, *Hydrologic data, *Documentation, *Surveys, *Groundwater, Water wells, Data storage and retrieval, Networks, Monitoring, Sampling, Instrumentation, Stations, Libraries, Investigations.
Identifiers: *Catalog of Information on Water Data.

An index is presented for use in retrieving data on groundwater measuring stations, from the Catalog of Information on Water Data, a record of activities in water data collection in the U.S. The Catalog is a file of information that is accessible through data-retrieval procedures--it contains information about water-data acquisition activities but does not contain the actual data, which must be obtained from the reporting agencies. Input to the Catalog consists of information supplied by Federal, State, and local agencies that acquire water data directly in the field and laboratory. All information is stored on media suitable for data processing, supplemented by microforms and maps. Information from the Catalog (output) is made available through indexes such as this publication, which is the index to the groundwater section of the Catalog. The indexes help the water-data user determine the data that are available for an area and also the data available from a reporting agency. The indexes to the 'Catalog of Information on Water Data' are indexes to separate sections of the Catalog. These indexes are designed to help the user determine what data are available that might serve his needs. In this index to groundwater stations, the stations are grouped (1) by States, (2) by counties within the States, and (3) by agencies within the counties. (Knapp-USGS)
W70-03658

BIBLIOGRAPHY OF THE GROUNDWATER RESOURCES OF NEW YORK THROUGH 1967,
Geological Survey, Albany, N.Y.
R. D. MacNish, R. C. Heath, L. E. Johnson, R. A. Wilkens, and R. D. Duryea.
New York State Water Resources Commission Bulletin 66, 1969. 186 p, 3 fig, 2 index.

Descriptors: *Bibliographies, *Groundwater, *New York, *Water resources, Water supply, Aquifers, Water wells, Water resources development, Water levels, Surveys, Data collections, Hydrologic data, Information retrieval.
Identifiers: Water Resources Bibliography.

A bibliography lists the groundwater resources studies in New York through 1967. Considerable information concerning New York water-bearing strata is available in a large variety of publications. The purpose of this bibliography is to list all these references in a single publication as an aid to future studies of New York's groundwater resources. In addition to the annotated bibliography, which summarizes the contents of each reference, a large part of the report is allocated to location and subject indexes of the references. The location index allows the reader to look under a specific area and find all publications dealing with any aspect of the groundwater resources of that area. The subject index permits the reader to look under the principal subjects related to groundwater resources and find material

related to areas in New York published on a specific subject. Published reports on the groundwater resources of New York range from detailed reports on small areas to general reports covering the entire State. (Knapp-USGS)
W70-03659

COMPILATION OF RESULTS OF AQUIFER TESTS IN TEXAS,
Geological Survey, Austin, Tex.
B. N. Myers.
Report published and distributed by the Tex Water Development Bd, P.O. Box 12386, Austin, Tex, 78711. Texas Water Development Board Report 98, July 1969. 532 p, 4 fig, 1 tab, 8 ref.

Descriptors: *Aquifers, *Texas, *Specific capacity, *Aquifer characteristics, *Data collections, Hydrologic data, Permeability, Drawdown, Transmissivity, Hydrologic properties, Documentation, Information retrieval.
Identifiers: *Aquifer testing, Pumping tests.

Aquifer tests made in Texas are compiled and evaluated. Some of the tests were conducted with little or no prior knowledge of the geologic framework of the aquifer; consequently, the reliability of such tests was questionable. However, on the basis of additional field testing or supporting geologic data, a few of the initially calculated results (some of which have been published) were revised. The form in which the material is presented is probably complete enough to permit the user of the data to reevaluate the results or make other interpretations. The data are grouped by county and where possible the latitude and longitude of the well are given. (Knapp-USGS)
W70-03660

CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO AREAL INVESTIGATIONS AND MISCELLANEOUS ACTIVITIES,
Geological Survey, Washington, D.C. Office of Water Data Coordination.
For primary bibliographic entry see Field 02E.
W70-03663

GEOLOGY AND GROUNDWATER RESOURCES OF OCEAN COUNTY, NEW JERSEY,
Geological Survey, Trenton, N.J.
Henry R. Anderson, and Charles A. Appel.
New Jersey State Division of Water Policy and Supply Special Report 29, 1969. 93 p, 29 fig, 10 tab, 20 ref.

Descriptors: *Water resources, *Aquifers, *Groundwater, *New Jersey, Water yield, Water levels, Water quality, Water supply, Artesian wells, Water wells, Data collections, Hydrologic data, Hydrogeology.
Identifiers: Ocean County (NJ).

The aquifers of Ocean County, New Jersey, are continental, near-shore marine, beach, or deltaic deposits of porous sand and gravel; the confining beds are chiefly deeper water marine deposits of clay and glauconite. Generally, the Coastal Plain formations are more permeable near their outcrop, where shallow-water deposits occur, than downdip where marine clays and glauconites occur. Groundwater in Ocean County is obtained principally from four artesian aquifer systems and a water-table aquifer. The formations of Cretaceous age form an artesian aquifer system 600 to 2,000 feet thick. Well yields of 500 to 1,000 gpm can be expected. Potable water in the aquifer system is soft (29 to 51 ppm hardness) and is generally high in iron content (0.66 to 3.2 ppm). Temperatures of 70 to 90 deg F make the water less desirable than shallow water for cooling purposes. (Knapp-USGS)
W70-03670

UPCONING OF FRESH WATER-SEA WATER INTERFACE BELOW PUMPING WELLS, FIELD STUDY,
Ministry of Agriculture, Jerusalem (Israel). Hydrological Service; and Water Planning for Israel Ltd., Tel-Aviv.
For primary bibliographic entry see Field 04B.
W70-03677

FORMATION AND GEOLOGICAL ROLE OF GROUNDWATERS,
Leningrad State Univ. (USSR).
A. Ye. Khod'kov, and G. Yu. Valukonic.
Leningrad, Izdatel'stvo Leningradskogo Universiteta, 1968. 216 p, 23 fig, 23 tab, 326 ref.

Descriptors: *Groundwater, *Groundwater recharge, *Hydrogeology, *Water structure, Water types, Water chemistry, Water circulation, Water sources, Fluid mechanics, Sediments, Density, Sedimentation, Atmospheric physics, Geochemistry, Infiltration, Aquifers.
Identifiers: Groundwater resources.

The present status of hydrogeology in the USSR is reviewed. Data pertaining to the composition, properties, and structure of water and the hydrosphere are given and the mechanism, development, and the hydrogeological effects of groundwaters are analyzed. The monograph contains the following chapters: the composition, structure, and properties of water; hydrosphere evolution; main genetic types of groundwaters and water circulation; the types of hydrodynamic zoning and the basic laws governing the fluid dynamics of condensing sediments; factors and processes of the formation of chemical composition of groundwaters; formation of groundwaters of sedimentary origin; formation of groundwaters of atmospheric origin; geochemical role of groundwater migration; and the geological role of groundwaters. (Gabriel-USGS)
W70-03679

HYDROLOGIC RECONNAISSANCE OF SKULL VALLEY, TOOELE COUNTY, UTAH,
Geological Survey, Salt Lake City, Utah; and Utah Dept. of Natural Resources. Div. of Water Rights.
J. W. Hood, and K. M. Waddell.
Utah Department of Natural Resources, Technical Publication No 18, 1968. 57 p, 11 tab, 8 fig, 34 ref, 2 maps.

Descriptors: *Arid lands, *Utah, *Groundwater, *Evapotranspiration, *Water quality, Groundwater basins, Groundwater recharge, Precipitation (Atmospheric), Groundwater movement, Water chemistry, Water yield, Hydrologic budget, Wells, Surface waters, Hydrogeology, Surveys.
Identifiers: *Skull Valley (Utah).

Skull Valley is about 50 miles long extending northward from Lookout Pass to the Great Salt Lake. The main groundwater supply underlies about 230,000 acres of unconsolidated rocks of the late Tertiary and Quaternary. All water input is precipitation, most of which falls on the surrounding mountains. Total annual estimated recharge ranges from 30,000 to 50,000 acre feet of which about 80 to 90% is lost to evapotranspiration. Perennial groundwater yield is estimated at 10,000 acre feet or less. Water quality is generally very poor with dissolved solids ranging up to 17,000 ppm. An estimated one million acre feet is of quality suitable for irrigation or domestic use. Most of this lies under the alluvium bordering the mountains on the south and eastern sides of the valley. (Crouse-Arizona)
W70-03811

ANISOTROPIC PERMEABILITY OF FRACTURED MEDIA,
Colorado School of Mines, Golden.
David T. Snow.
Water Resources Research, Vol 5, No 6, p 1273-1289, Dec 1969. 17 p, 5 fig, 5 plate, 32 ref.

Descriptors: *Permeability, *Anisotropy, *Porous media, *Fractures (Geology), *Mathematical models, Model studies, Darcys law, Statistical models, Mathematical studies, Discharge (Water), Flow, Groundwater movement.
Identifiers: Anisotropic permeability, Fractured porous media.

The mathematical equivalents of parallel plate openings are used to simulate real fractures dispersed in orientation, distributed in aperture, and of arbitrary spacing. The discharge of each conductor is a second rank tensor proportional to the cube of aperture and to the projection of a hydraulic gradient generally parallel to no conductor. Components of discharge through each intersecting conductor and components of discharge through intervening pervious blocks may be added. The reciprocal of specific surface of the fracture system is a weighting factor for the tensor sum, which is the anisotropic Darcy's law permeability of an equivalent continuous medium. Special cases of one, two, and three joint sets are modeled by applying Monte Carlo methods to pair orientations of individual planes sampled from Fisher dispersions with apertures sampled from skewed normal distributions. Statistics of the orientation of principal axes and of principal permeabilities are developed to show the relationship between joint geometry and anisotropy and to assess its variations. (Knapp-USGS)
W70-03870

DETERMINING SPECIFIC YIELD OF THE OGALLALA AQUIFER BY THE NEUTRON METHOD,
Agricultural Research Service, Bushland, Tex. Southwestern Great Plains Research Center.
Ordie R. Jones, and Arland D. Schneider.
Water Resources Research, Vol 5, No 6, p 1267-1272, Dec 1969. 6 p, 5 fig, 2 tab, 10 ref.

Descriptors: *Specific yield, *Aquifers, *Alluvium, *Nuclear moisture meters, Texas, Instrumentation, Surveys, Radioactivity, Water levels, Water level fluctuations, Permeability.
Identifiers: Ogallala Formation, Neutron moisture meters, Pumping tests, Aquifer testing.

The specific yield of the Ogallala formation, a water table aquifer, was determined with a neutron moisture meter. An access tube penetrated a 12-foot section of the aquifer. This section was saturated by recharging water to the aquifer and then dewatered by pumping for 11 days. The specific yield of the aquifer was calculated from neutron moisture measurements made at saturation after most gravity drainage had occurred. The average specific yield for 25 measurements made at 1/2-foot intervals was 0.22. This value compares favorably with the specific yields determined by tracer techniques and laboratory analysis of cores. However, the specific yield determined by the neutron method was 50% greater than the specific yield determined by pumping tests. (Knapp-USGS)
W70-03871

AVAILABILITY OF GROUNDWATER IN WAYNE COUNTY, IOWA,
Geological Survey, Iowa City, Iowa.
J. W. Cagle.
Iowa Geological Survey Water Atlas No 3, 1969. 33 p, 10 fig, 6 tab.

Descriptors: *Water resources, *Water quality, *Groundwater, *Aquifers, *Iowa, Nitrates, Saline water, Water chemistry, Water supply, Water yield, Water wells, Water pollution sources, Geology, Glacial drift.
Identifiers: Wayne County (Iowa).

Information is presented on the availability and quality of groundwater in Wayne County, one of several counties in southern Iowa affected by a shortage of good-quality water. Only locally and in limited areas, or only after extensive water-quality treatment, are suitable supplies of groundwater

available to satisfy the water needs. Bedrock aquifers yield variable small amounts of moderately to highly mineralized water. Surficial aquifers comprising glacial drift and alluvium are estimated to yield up to 45 gpm in some areas; an availability map indicates the areas where water supplies can be developed. Dissolved-solids concentrations range from about 470 mg/l in the alluvium to over 3,600 mg/l in the deep (more than 100 feet) glacial drift. Many shallow (100 feet or less) supplies presently in use contain high concentrations of nitrate and chloride, and these concentrations are attributed to localized contamination. Wells in the alluvium and shallow drift that are properly constructed and located are expected to yield satisfactory quality water. (Knapp-USGS)
W70-03879

RADIOCARBON DETERMINATIONS APPLIED TO GROUNDWATER HYDROLOGY,
Geological Survey, Washington, D.C.; and Geological Survey, Denver, Colo.
Bruce B. Hanshaw, Meyer Rubin, and William Back.
In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 117-118, 1967. 2 p, 3 ref.

Descriptors: *Carbon radioisotopes, *Radioactive dating, *Groundwater movement, *Tracking techniques, *Tracers, Acidity, Alkalinity, Carbonates, Carbon dioxide, Groundwater recharge, Saturation, Carbon, Water chemistry, Geohydrologic units, Hydrogeology.
Identifiers: *Groundwater hydrology.

Field determination of pH, alkalinity and the use of stable isotopes can correct some chemical problems associated with use of radiocarbon in hydrology. These chemical problems are: (1) Determination of initial C-14 levels in the recharge area; (2) water saturation with respect to carbonate minerals; (3) isotopic exchange after saturation is attained; and (4) introduction of carbon dioxide from noncarbonate sources. The amount of nonradiogenic carbon introduced into groundwater can be determined by taking advantage of the range of C-13 values in nature. Atmospheric carbon dioxide is depleted only slightly in C-13, whereas plants, wood and coal are quite depleted in C-13. In contrast, carbon dioxide from thermal areas is commonly much enriched in C-13. In aquifers that contain carbonate minerals, the C-13 correction can be applied to determine the amount of nonradiogenic carbon dilution in order to correct the raw C-14 age and calculate a corrected C-14 age. Field studies have been conducted in selected aquifers (1) to measure the relative C-14 concentrations and C-13 values; (2) distinguish between the waters from different geohydrologic environments; (3) calculate velocity of groundwater movements; and (4) delineate areas of significant recharge. (Carstea-USGS)
W70-03890

DEVELOPMENT OF ISOTOPE METHODS APPLIED TO GROUNDWATER HYDROLOGY,
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotopes.
For primary bibliographic entry see Field 07B.
W70-03891

GROUNDWATER FLOW AND DIRECTION MEASUREMENT BY MEANS OF RADIOISOTOPES IN A SINGLE WELL,
J. Mairhofer.
In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 119-129, 1967. 11 p, 12 fig, 6 ref.

Descriptors: *Groundwater movement, *Radioisotopes, *Radioactivity techniques, *Tracers, Wells, Tritium, Precipitation (Atmospheric), Flow measuremer ., Aquifers, Permeability, Nuclear explosions, Hydrogeology.
Identifiers: *Point dilution method, Groundwater flow measurement.

The point dilution method was used in studies of aquifer flow velocity measurements using single, cased water wells. The casing was sealed above and below the measuring point in the well. The space between the screen and hole must be tight in order to minimize vertical movement. Radioisotope measurements of aquifer permeability and groundwater movement are discussed. The chemical form of the injected tracer must be taken into account to correct for adsorption, etc. (Carstea-USGS)
W70-03892

USE OF CHEMICAL AND RADIOACTIVE TRACERS AT THE NATIONAL REACTOR TESTING STATION, IDAHO,
National Reactor Testing Station, Idaho Falls, Idaho.
Donald A. Morris.
In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 130-142, 1967. 13 p, 11 fig, 3 tab, 4 ref.

Descriptors: *Radioactivity techniques, *Tracers, *Tritium, *Groundwater movement, *Tracking techniques, Idaho, Waste disposal, Nuclear reactors, Flow rates, Aquifers, Basalts, Dye releases, X-ray fluorescence, Hydrogeology.
Identifiers: *National Reactor Testing Station, Chemical tracers, Radioactive tracers.

Chemical and radioactive tracers were used in studies of the geology and the hydrology of the basalt terrane at the National Reactor Testing Station. A salt tracer, used near waste disposal from the Idaho Chemical Processing Plant, indicated rates of flow ranging from 15 to 50 ft/day in the regional groundwater reservoir, and a sodium fluorescein dye indicated an average rate of flow of about 23 ft/day. Recent studies using tritium indicated average rates of flow of about 54 ft/day based on first arrival and from 10 to 13 ft/day based on the arrival of the center of mass or maximum tritium concentration. Studies of the water perched in the alluvium and basalt underlying the Test Reactor Area indicated a rate of flow of about 2-10 ft/day. Long-range tritium studies in the regional groundwater reservoir in the Central Facilities Area indicated rates of flow of 6-8 ft/day under normal hydraulic gradients of 5 ft/mile at distances of 4-5 miles from points of injection. (Carstea-USGS)
W70-03893

RADIOCARBON AGES OF GROUNDWATER IN AN ARID ZONE UNCONFINED AQUIFER,
Instituto Venezolano de Investigaciones Cientificas, Caracas.
M. A. Tamers.
In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 143-152, 1967. 10 p, 2 fig, 3 tab, 17 ref.

Descriptors: *Carbon radioisotopes, *Radioactive dating, *Aquifer characteristics, Carbonates, Carbon dioxide, Bicarbonates, Groundwater recharge, Saline water intrusion, Water supply, Water resources development, Arid climates.
Identifiers: *Venezuela, *Maracaibo, *Groundwater dating.

The use of the naturally occurring stable isotope C-13 was studied to estimate the amount of limestone that has dissolved in groundwater. Limestone contains essentially no C-14, and has 2.5% more C-13 than plants and 0.8% more than atmospheric carbon dioxide. Advantage can be taken of these differences in C-13 to estimate the contribution of dissolved carbonate derived originally from limestone. The dissolved carbon dioxide and bicarbonate content in the groundwater aquifer of the city of Maracaibo, Venezuela, were used for radiocarbon dating. The radiocarbon activities were corrected for the dilution of the activity by limestone. The experimental results suggest that the groundwater aquifer is not being recharged and at the present rate of water consumption, the supply could last 350 years. If population growth is taken into consideration, the groundwater aquifer would be exhausted in less than 80 years. The probability of sea water intrusion into the aquifer is discussed (Carstea-USGS)
W70-03895

TECHNIQUES OF GROUNDWATER TRACING USING RADIONUCLIDES,
Atomic Energy of Canada Ltd., Chalk River (Ontario).
W. F. Merritt.
In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 169-170, 1967. 2 p, 2 ref.

Descriptors: *Tracers, *Groundwater movement, *Radioisotopes, Tracking techniques, Tritium, Gamma rays, Analytical techniques, X-ray analysis, Carbon radioisotopes, Iodine radioisotopes, Phosphorous radioisotopes.
Identifiers: *Groundwater tracing, Liquid scintillation.

Radionuclide techniques commonly used for tracing groundwater are discussed. Tritium is cheap, easy to handle and moves with groundwater, but is difficult to count. Pure beta emitters (Sr-35, P-32, C-14) are easy to count, but the last two may be fixed by soil bacteria. Gamma emitters (Br-82, I-131) can be detected in the field but may require shielding during handling. Liquid scintillation, windowless flow proportional, and well-type crystal counting methods were compared. Techniques for measuring the direction and velocity of groundwater flow used at Chalk River Nuclear Laboratories are given. (Carstea-USGS)
W70-03896

ENVIRONMENTAL TRITIUM STUDIES AT THE NATIONAL REACTOR TESTING STATION,
Atomic Energy Commission, Idaho Falls, Idaho.
For primary bibliographic entry see Field 05B.
W70-03898

THE USE OF A TRACER TEST TO VERIFY AN ESTIMATE OF THE GROUNDWATER VELOCITY IN FRACTURED CRYSTALLINE ROCK AT THE SAVANNAH RIVER PLANT NEAR AIKEN, SOUTH CAROLINA,
Geological Survey, Aiken, S.C.
I. Wendell Marine.
In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 171-179, 1967. 9 p, 9 fig, 1 tab, 8 ref.

Descriptors: *Tracers, *Crystalline rocks, *Groundwater movement, *South Carolina, Structural geology, Observation wells, Tritium, Radioisotopes, Radioactivity techniques, Radioactive wastes, Waste storage, Fractures (Geology), Tunnels.
Identifiers: *Savannah River, Groundwater velocity, Schist, Gneiss.

The storage of high-level radioactive wastes in unlined tunnels excavated in crystalline rock about 1500 feet beneath the surface was found to be technically feasible at the Savannah River Plant, South Carolina. Most of the crystalline rock consists of schist and gneiss and is nearly impermeable, with very few fractures. Estimates of the natural groundwater velocity were 0.5 ft/yr in nearly impermeable rock and 5.4 ft/yr for zones of more open fractures. The validity of these hydraulic estimates was tested by using tritium as a tracer and in pumping and swabbing tests in observation wells. The peak concentration of tritium was reached in about one year, yielding an average groundwater velocity of 1,760 ft/yr. The predicted average velocity for the tracer was 320 ft/yr which is 2.5

times lower than the measured velocity. (Carstea-USGS)
W70-03899

SELECTED ANALYTICAL METHODS FOR WELL AND AQUIFER EVALUATION,
Illinois State Water Survey Div., Urbana.
For primary bibliographic entry see Field 04B.
W70-03943

2G. Water in Soils

INFILTRATION INDUCED SOIL INSTABILITIES,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
Donald Dean Adrian.
Groundwater, Vol 8, No 1, p 29-36, Jan-Feb 1970. 8 p, 6 fig, 7 ref. PHS Grant WP-0026 and FWPCA Grant 17070-DZS.

Descriptors: *Infiltration, *Percolation, *Capillary action, Soil water movement, Model studies, Hydraulic models, Infiltrometers, Permeameters, Hydraulic conductivity, Permeability.
Identifiers: Infiltration stability, Soil air movement.

Theoretical analyses predicted and experimental observations confirmed a mechanism by which strong capillary forces hindered instead of helped promote infiltration into soils. Infiltration into an unsaturated soil overlying an impermeable barrier displaces the air from the soil interstices. Unable to escape downward, the air may escape upward in bubbles traveling through large pores, or, if the pores are small and the capillary forces are large, the air is compressed between the wetting front and the barrier. This reduces the infiltration rate and may result in an almost stable wetting front. Under certain calculable conditions the air pressure build-up is sufficient to cause rupturing of the soil, forming a cavity. The air-filled cavity breaks the flow passages and percolation ceases through pores terminating in the cavity. Grain size and packing play a role by limiting the capillary pressure build-up and the bubbling pressure. (Knapp-USGS)
W70-03648

FIELD MEASUREMENT AND USE OF SOIL-WATER PROPERTIES,
Oklahoma State Univ., Stillwater.
J. M. Davidson, L. R. Stone, D. R. Nielsen, and M. E. LaRue.
Water Resources Research, Vol 5, No 6, p 1312-1321, Dec 1969. 10 p, 16 fig, 4 tab, 15 ref.

Descriptors: *Soil water movement, *Hydraulic conductivity, *Moisture content, *Hysteresis, On-site tests, Mathematical studies, Darcy's law, Drainage, Capillary action, Capillary conductivity.
Identifiers: Hydraulic conductivity-water content relations.

The hydraulic conductivity versus soil-water content relation for different soil depths was measured in the field for three soil profiles. The soils varied in physical properties from homogeneous to heterogeneous with depth and from loamy sand to silty clay in surface soil texture. Hydraulic conductivity values calculated from drainage data taken during different time intervals compared favorably with each other and showed no measurable hysteresis. The soil-water flux at various soil depths with and without evaporation at the soil surface was measured. The rate at which water drained from each of the profiles was predicted using Darcy's equation and some simplifying assumptions. The agreement between theoretical and measured results is discussed in terms of soil heterogeneity with depth. (Knapp-USGS)
W70-03675

DESIGN OF A NEUTRON SCATTERING WATER CONTENT GAGE FOR SOILS,
Illinois Univ., Urbana.
For primary bibliographic entry see Field 07B.
W70-03686

DOWNWARD MOVEMENT OF SOIL MOISTURE TRACED BY MEANS OF HYDROGEN ISOTOPES,
Heidelberg Univ. (West Germany). Physics Inst., C-14 Lab.
U. Zimmermann, K. O. Munnich, and W. Roether.
In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 28-36, 1967. 9 p, 5 fig, 1 tab, 18 ref.

Descriptors: *Soil moisture, *Soil water movement, *Deuterium, *Tracers, Hydraulic gradient, Permeability, Analytical techniques, Evapotranspiration, Groundwater recharge, Hygroscopic water, Hydrologic budget, Water balance.
Identifiers: *Downward soil moisture movement, Labeled water.

Experiments using deuterium confirmed the layered movement of soil moisture. Surfaces of 4 sq meters representing two German soils were 'rained' with about 5 mm of water containing 1.5% deuterium oxide. Soil samples were collected periodically to trace the downward movement of the labeled water. This labeled layer had a distinguishable boundary between the older and younger rainwater in soil. The water supply and not the hydraulic gradient and permeability is the limiting factor of water movement in unsaturated soils. The following systematic errors are listed and briefly discussed: (1) the depth of water movement may vary according to soil irregularities; (2) tagged water may be bypassed in both directions; (3) the standard moisture determination does not take into account the very strongly bound water which may be capable of isotopic exchange. Isotope tracing provides a method to calculate a balance between the amount of rainfall after the date of tagging and the fraction of this rain that is still present in soil. The difference is considered to be lost by evapotranspiration. (Carstea-USGS)
W70-03689

YIELD-PROTEIN RELATIONSHIPS IN WHEAT GRAIN, AS AFFECTED BY NITROGEN AND WATER,
Nebraska Univ., Lincoln.
G. L. Terman, R. E. Ramig, A. F. Dreier, and R. A. Olson.
Agronomy Journal, Vol 61, No 5, p 755-759, Sept-Oct 1969. 6 fig, 17 ref.

Descriptors: *Crop production, *Moisture availability, *Nitrogen, *Plant growth, *Proteins, Semiarid climates, Wheat, Moisture stress, Irrigation, Dry farming, Water, Nebraska, Soil moisture, Soil-water-plant relationships, Crop response.

The effect of applied nitrogen on wheat yield and protein under different moisture conditions was tested in semiarid Nebraska. Applied nitrogen increased total yield if adequate soil moisture was available. Under dryland farming conditions where the wheat was subject to severe moisture stress, there was little or no increase in yield but there was a significant increase in protein content. In general percentage of protein decreased as yields increased, but the level of protein at the different yield rates was increased with adequate irrigation. Moisture supply appeared to be the chief factor determining response to applied nitrogen. (Crouse-Arizona)
W70-03800

SOIL RESPIRATORY ACTIVITY AND ORGANIC MATTER DEPLETION IN AN ARID NEVADA SOIL,
Nevada Univ., Reno.
S. D. Lyda, and G. D. Robinson.
Soil Science Society of America, Proceedings, Vol 33, No 1, p 92-94, 1969. 1 tab, 3 fig, 12 ref.

Descriptors: *Soil treatment, *Respiration, *Soil microorganisms, *Organic matter, *Arid lands, Nevada, Microenvironment, Metabolism, Oxygen requirements, Sudangrass, Oats, Alfalfa, Soil amendments, Manometers, Oxygen, On-site investigations, Soil environment, Sampling.
Identifiers: *Crop residues.

High correlations have been observed between soil respiratory activity and actual microbial counts. During a 4 year period mature crop residues of alfalfa, oats, and sudan have been incorporated in an irrigated sandy loam in arid southern Nevada in an attempt to reduce Phymatotrichum root rot. This paper presents the results of this operation in the field for 2 years as well as supporting laboratory studies of the same residues at various amendment rates. In the field a close relationship was noted between respiration rate and organic matter content which decreased slowly over a 6-month period. In the laboratory the same residues were added at the 1, 2, 3, and 4% by weight levels. Maximum activity was noted during the first 2 weeks for the 2, 3, and 4% levels. Respiration rate was proportional to residue concentration. However, increments were not additive. The results suggest that a given soil could become saturated with organic matter and at that point other factors would become limiting on respiration, such as available oxygen or accumulation of metabolic products. (Crouse-Arizona)
W70-03801

ROOTZONE SALT PROFILES AND ALFALFA GROWTH AS INFLUENCED BY IRRIGATION WATER SALINITY AND LEACHING FRACTION,
Agricultural Research Service, Riverside, Calif. Soil and Water Conservation Research Div.; and Agricultural Research Service, Riverside, Calif. Salinity Lab.
C. A. Bower, G. Ogata, and J. M. Tucker.
Agronomy Journal Vol 61, No 5, p 783-785, Sept-Oct 1969. 1 tab, 3 fig, 2 ref.

Descriptors: *Arid lands, *Irrigation water, *Drainage water, *Saline water, *Plant growth, Saline soils, Lysimeters, Alfalfa, California, Root zone, Soil-water-plant relationships.

Alfalfa was grown in 24 lysimeters at Riverside, California, with 12 irrigation water salinity and leaching fraction treatments. Plant yield was related to the salinity that developed in the root zone. The first increments of leaching were most effective in preventing salt accumulation in the soil. At high leaching fractions much of the water applied beyond that required for evapotranspiration was of little effect in lowering soil salinity. (Crouse-Arizona)
W70-03807

VAPOR LOSSES THROUGH SOIL MULCH AT DIFFERENT WIND VELOCITIES,
Punjab Agricultural Univ., Hissar (India). Dept. of Soils.
C. L. Acharya, and S. S. Prihar.
Agronomy Journal, Vol 61, No 5, p 666-669, Sept-Oct 1969. 3 tab, 3 fig, 6 ref.

Descriptors: *Mulching, *Evaporation control, *Porosity, *Water vapor, *Wind velocity, Soil moisture, Evaporation, Laboratory tests, Soil physical properties, Vapor pressure, Arid lands.
Identifiers: *India, Mulch porosity, Mulch thickness, Vapor loss.

When intervals between irrigations are long, the soil surface dries and a large proportion of moisture loss occurs in vapor form through the dry surface layer. The authors report a laboratory study to determine rate of vapor losses with different wind velocities and mulch porosities. The soil was a sandy loam and the mulch was prepared from a sandy loam treated with water repellent polyvinyl alcohol. The ratio of evaporation through a dry layer to that from a continuously wet surface was a function of the thickness of the dry layer over a cer-

tain range. Within this range the vapor loss could be expressed with a regression equation as a function of wind velocity and porosity of the mulch. (Crouse-Arizona)
W70-03808

RUNOFF INDUCEMENT IN ARID LANDS,
National and Univ. Inst of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research.
For primary bibliographic entry see Field 03B.
W70-03809

SOIL FACTORS INFLUENCING PERCOLATION TEST PERFORMANCE,
Pennsylvania State Univ., University Park. Dept. of Soil Science.
B. D. Derr, R. P. Matelski, and G. W. Petersen.
Soil Science Society America Proceedings, Vol 33, No 6, p 942-946, Nov-Dec 1969. 5 p, 5 tab, 19 ref.

Descriptors: *Soil water movement, *Percolation, Statistical methods, Percolating water, Soil environment, Clays, Silts, Soil texture, Slopes, Drainage.
Identifiers: Drainage classes, Fragipans, Subsoil consistence, Percolation tests.

Percolation rates were measured at 250 sites in Pennsylvania. Statistical analysis of the data showed that there was considerable variation between percolation test rates within sites. The variability of individual tests between sites on the same soil series is generally greater than the variability of individual tests within sites. The clay contents and drainage classes were negatively correlated. The silt content and coarse fragments of the subsoil were positively correlated. Drainage classes, fragipans, subsoil texture, surface coarse fragments, type and grade of subsoil structure, parent material, and slope classes were significantly related to percolation rates. Moderately well, somewhat poorly, and poorly drained soils were influenced by moist subsoil consistence, fragipans, subsoil structure grade, and subsoil texture. Soil drainage classes are closely related to percolation rates. (Carstea-USGS)
W70-03850

NUMERICAL METHOD FOR ESTIMATING SIMULATANEOUS FLOW OF WATER AND SALT IN UNSATURATED SOILS,
Colorado State Univ., Fort Collins. Dept. of Soil Sciences; and Utah State Univ., Logan. Dept. of Soils and Meteorology.
E. Bresler, and R. J. Hanks.
Soil Science Society America Proceedings, Vol 33, No 6, p 827-832, Nov-Dec 1969. 6 p, 5 fig, 13 ref. OWRR Project B-008-COLO.

Descriptors: *Unsaturated flow, *Model studies, *Soil water movement, Numerical analysis, Mathematical studies, Saline soils, Infiltration, Evaporation, Water distribution (Applied), Diffusion, Ion exchange, Fertilizers, Herbicides, Pesticides, Water chemistry.
Identifiers: Unsaturated soils, Salt distribution.

A numerical solution of noninteracting salt flow simultaneously with water in unsaturated soil was devised and programmed. Solutions were obtained for infiltration, redistribution, and evaporation under different wetting and boundary conditions. The effect of diffusion on salt distribution was neglected in the computations. The method was found to give reasonable results for noninteracting solutes. When compared with measured total salt distribution after one wetting and drying cycle, the model gave fairly good results when a source term was added to the computations. The method can be applied to some practical problems, such as leaching of salts and fertilizer movement. (Carstea-USGS)
W70-03851

INFILTRATION, REDISTRIBUTION, AND SUBSEQUENT EVAPORATION OF WATER FROM SOIL AS AFFECTED BY WETTING RATE AND HYSTERESIS,
Colorado State Univ., Fort Collins. Dept. of Soil Science; and Utah State Univ., Logan. Dept. of Soils and Meteorology.
E. Bresler, W. D. Kemper, and R. J. Hanks.
Soil Science Society America Proceedings, Vol 33, No 6, p 832-840, Nov-Dec 1969. 9 p, 10 fig, 1 tab, 15 ref. OWRR Project B-008-COLO.

Descriptors: *Soil water movement, *Water transfer, *Soils, Columns, Infiltration, Wetting, Evaporation, Hysteresis, Flow, Moisture content.
Identifiers: *Soil columns, Water suction.

Soil columns were wetted at three different rates which caused unequal water content profiles during infiltration. Hysteresis in soil water content-water suction relationships has a larger effect on water redistribution as the wetting rate increases. The effect tends to keep the water content higher and the zone of wetting shallower during the redistribution stage when rates of wetting are faster. At any given redistribution time, higher water content and lower wetting depth cause the subsequent evaporation to be greater. Evaporation was directly related to the previous wetting rates. The experimental results are in agreement with the results of numerical solution to water flow equations. (Carstea-USGS)
W70-03852

COMPARISON OF COMPUTED AND MEASURED MOISTURE REDISTRIBUTION FOLLOWING INFILTRATION,
Department of Agriculture, Ottawa (Ontario). Soil Research Inst.
W. J. Staple.
Soil Science Society America Proceedings, Vol 33, No 6, p 840-847, Nov-Dec 1969. 8 p, 10 fig, 1 tab, 22 ref.

Descriptors: *Moisture content, *Soil water movement, *Infiltration, Particle size, Hydraulic conductivity, Hysteresis, Soils, Diffusivity.
Identifiers: Water-holding capacity, Tension curves, Soil water redistribution.

Redistribution of water was measured in three soils following two different initial amounts of infiltration. The measured redistribution profiles were compared with those computed from the flow equation taking into account hysteresis in the drying tension vs water content relationship. Agreement between measured and computed moisture profiles was considered satisfactory. A procedure was outlined for determining wetting diffusivities and conductivities in the wetting front on the basis of soil moisture profiles obtained during redistribution. The different shapes of the drying scanning tension curves provided some insight into the differences in particle size distribution that influence the water-holding capacity of soils. (Carstea-USGS)
W70-03853

THERMO-OSMOSIS THROUGH COMPACTED SATURATED CLAY MEMBRANES,
Gulf Research and Development Co., Pittsburgh, Pa.
C. Dirksen.
Soil Science Society America Proceedings, Vol 33, No 6, p 821-826, Nov-Dec 1969. 6 p, 1 fig, 5 tab, 26 ref.

Descriptors: *Osmosis, *Membranes, *Soil water movement, *Water chemistry, Permeability, Hydraulic properties, Kaolinite, Bentonite, Sodium, Temperature, Flow, Unsaturated flow, Clays.
Identifiers: *Clay membranes, Thermo-osmosis, Na-kaolinite, Na-bentonite.

Hydraulic permeability of saturated Na-kaolinite decreased more rapidly with increasing compaction pressure than did thermo-osmotic permeability. This resulted in a moderate increase of thermo-osmotic pressure difference. Sodium bentonite showed a decrease in the thermo-osmotic pressure difference at a compaction pressure of 7.0 kg/sq cm. At the same time, the thermo-osmotic permiability increased with increasing average temperature. Thermal flow of water occurred from the warm to the cold side and was generally less than that reported for liquid water in unsaturated solids. The apparent activation energy of thermo-osmotic water transport in Na-bentonite was estimated to be about 29 cal/g water; the heat of transport was more than 3 orders of magnitude smaller. (Carstea-USGS)
W70-03859

INFILTRATION RATES AS AFFECTED BY DESERT VEGETATION,
Arizona Univ., Tucson.
Forest P. Lyford, and Hasan K. Qashu.
Water Resources Research, Vol 5, No 6, p 1373-1376, Dec 1969. 4 p, 3 fig, 3 tab, 4 ref. OWRR Project A-012-ARIZ.

Descriptors: *Infiltration, *Vegetation effects, *Arid lands, Soil-water-plant relationships, On-site tests, Soil water movement.
Identifiers: Paloverde, Creosote bush.

Infiltration of water into two soils measured at radial distances from the stems of paloverde (Cercidium microphyllum) and creosote bush (Larrea tridentata) were found to average nearly three times greater under plants than in the openings. Bulk density was lower and organic matter content was higher in topsoil under plants than in the openings. (Knapp-USGS)
W70-03864

EVALUATION OF FLOW PARAMETERS,
Department of Agriculture, Ottawa (Ontario). Soil Research Inst.
W. J. Staple.
Proceedings of Hydrology Symposium No 6 on Soil Moisture, Saskatchewan University, Nov 15-16, 1967, p 81-100, National Research Council, Ottawa, Canada 1968. 20 p, 3 fig, 2 tab, 32 ref.

Descriptors: *Soil water movement, *Flow characteristics, *Unsaturated flow, Hydraulic conductivity, Diffusivity, Soil structure, Bulk density, Hydraulic gradient, Soils, Soil water, Steady flow, Unsteady flow, Boundary processes, Hysteresis.
Identifiers: *Flow parameters.

The parameters determining water flow through unsaturated soil are conductivity or diffusivity coefficients. In the simplest situation, when soil moisture tension is a unique function of moisture content, conductivity K and diffusivity D are proportionality factors relating flow rates respectively to hydraulic and moisture content gradients. It follows that K and D may be obtained in flow experiments in which the relevant flow rates and gradients are measured. Conductivity coefficients vary a million-fold in the soil moisture range of interest to hydrologists. No one experimental arrangement is adequate to obtain K for the whole moisture range. Indirect determinations involving diffusivity have been used to extend the data to drier soils, but for some moisture contents satisfactory methods are not yet available. In some cases, improved conductivity data may be inferred in comparing trial computations of moisture movement with experimentally determined moisture profiles. (Carstea-USGS)
W70-03880

MECHANICS OF THE MOVEMENT OF MOISTURE AND CHEMICAL SUBSTANCES IN SOILS,
Guelph Univ. (Ontario). Dept. of Soil Science.
D. E. Elrick, and J. H. M. Aalders.
Proceedings of Hydrology Symposium No 6 on Soil Moisture, Saskatchewan University, Nov 15-16, 1967, p 51-79, National Research Council, Ottawa, Canada, 1968. 29 p, 3 fig, 2 tab, 32 ref.

Descriptors: *Soil water movement, *Dissolved solids, *Saturated flow, *Unsaturated flow, Water vapor, Diffusion, Air circulation, Convection, Interfaces, Osmotic pressure, Percolation, Chemical potential, Adsorption.
Identifiers: Matric potential, Osmotic potential, Gravitational potential.

There are 3 groups of forces acting on soil water, namely, matric, osmotic and body forces. A brief description of these forces is given. Isothermal liquid and vapor flow theory is applied to soil moisture movement. Movement of water through both saturated and unsaturated zones is influenced by various potentials such as matric, gravitational, pressure, adsorption, and chemical. Substances dissolved in soil water or present in soil air can move by diffusion or by a combination of diffusion and convection. An analysis of the transport processes of chemical substances in the liquid or vapor phase is included. The interactions taking place at the solid-liquid interface can complicate the overall transport of water and chemical substances. (Carstea-USGS)
W70-03881

ELECTRICAL ANALOGUES AND DIGITAL COMPUTERS FOR ESTIMATING UNSATURATED WATER FLOW IN SOILS,
Agricultural Research Service, Fort Collins, Colo. Soil and Water Conservation Research Div.
R. J. Hanks.
Proceedings of Hydrology Symposium No 6 on Soil Moisture, Saskatchewan University, Nov 15-16, 1967, p 119-131, National Research Council, Ottawa, Canada, 1968. 13 p, 6 fig, 19 ref.

Descriptors: *Soil water movement, *Analog models, *Digital computers, Soil moisture, Computers, Unsaturated flow, Diffusivity, Dimensional analysis, Soils, Model studies, Analog computers, Computer models.
Identifiers: Hydrologic model studies.

Many complex problems related to water flow through soils may be solved by using electrical analogs and digital computers. Where diffusivity is a constant, solution of unsaturated water flow in soils is very convenient. Analog models are quite inexpensive. Variables can be easily changed and solutions obtained quickly. Analog models are good training tools. The main disadvantages of analogs are: (1) They are limited to the solution of special problems and (2) the solutions are not as accurate as those obtained with digital computers. For one-dimensional flow, the digital computers allow for solution of almost any problem that can be formulated. (Carstea-USGS)
W70-03882

SIMILITUDE FOR PARTIALLY SATURATED FLOW SYSTEMS,
Department of Agriculture, Lethbridge (Alberta). Research Station.
G. E. Laliberte, A. T. Corey, R. H. Brooks, G. L. Corey, and D. B. McWhorter.
Proceedings of Hydrology Symposium No 6 on Soil Moisture, Saskatchewan University, Nov 15-16, 1967, p 101-118, National Research Council, Ottawa, Canada, 1968. 18 p, 3 fig, 22 ref.

Descriptors: *Unsaturated flow, *Mathematical models, *Hydraulic models, *Soil water movement, Hydrologic properties, Unsteady flow, Steady flow, Soils, Boundary processes, Hysteresis, Dimensional analysis.
Identifiers: Partially saturated flow.

The use of mathematical and hydraulic models to solve hydrological problems is reviewed. When mathematical approaches cannot provide solutions for physical phenomena, the use of mathematical and hydraulic models may prove useful in understanding these phenomena. Similitude theory was verified in the laboratory for modeling steady and transient flow of two immiscible fluids in saturated and partially saturated soil systems. More research is necessary to find solutions of such problems as boundary effects, medium-fluid interactions, entrapped air, and hysteresis. (Carstea-USGS)
W70-03883

THE EFFECT OF SOIL MOISTURE ON INFILTRATION AS RELATED TO RUNOFF AND RECHARGE,
Saskatchewan Univ., Saskatoon. Dept. of Agricultural Engineering.
Don M. Gray, and D. I. Norum.
Proceedings of Hydrology Symposium No 6 on Soil Moisture, Saskatchewan University, Nov 15-16, 1967, p 133-153, National Research Council, Ottawa, Canada, 1968. 21 p, 6 fig, 1 tab, 25 ref.

Descriptors: *Soil moisture, *Infiltration, *Groundwater recharge, *Surface runoff, *Surface-groundwater relationships, Capillary action, Gravitational water, Moisture content, Watersheds (Basins), Capillary conductivity, Moisture tension, Soils.
Identifiers: Capillary conductivity-moisture content curves, Moisture-tension relationships.

In the infiltration process, water enters the soil surface under the combined influences of gravity and capillary forces. The rate of infiltration may be governed by two separate processes: (1) Entry of water through the surface layer and (2) downward movement or percolation of water through the soil profile. The effects of soil moisture on moisture profiles and infiltration rate, the effect of soil moisture gradient, and the interrelationships of soil moisture and other factors influencing infiltration are briefly discussed. Increasing the initial soil moisture content increases the velocity at which the wetting front moves but decreases the infiltration rate. The initial moisture content of the soil affects the shape of the moisture distribution profile. The infiltration potential for soils in a watershed could be evaluated from soil moisture measurements such as: (1) The capillary conductivity-moisture content curve; (2) the moisture-tension relationship, and (3) an experimental relation between the soil moisture content and infiltration rate. Infiltration in frozen and unfrozen soils is also discussed. (Carstea-USGS)
W70-03884

RELATIONSHIPS BETWEEN SOIL MOISTURE ACTUAL AND POTENTIAL EVAPOTRANSPIRATION,
Department of Agriculture, Ottawa (Ontario). Plant Research Inst.
For primary bibliographic entry see Field 02D.
W70-03885

FRACTIONATION OF TRITIUM AND DEUTERIUM IN SOIL WATER,
Geological Survey, Washington, D.C.
Gordon L. Stewart.
In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 159-168, 1967. 10 p, 1 fig, 8 tab, 5 ref.

Descriptors: *Radioactive dating, *Tracers, *Deuterium, *Tritium, *Distillation, Soil moisture, Clays, Tracking techniques, Ion exchange, Diffusion, Kaolinite, Montmorillonite, Groundwater movement, Surface waters, Sands.
Identifiers: *Tritium fractionation, *Deuterium fractionation, Isotopic exchange.

Laboratory investigations are being conducted to determine the potential capabilities of hydrogen isotopes in age-dating techniques and as tracers for ground and surface waters. Preliminary results show that tritium and deuterium interact with clay minerals as water diffuses through Davidson clay. The data suggest that two stages characterize this interaction with clay minerals: a rapid exchange with more labile hydroxyl groups, followed by exchange with other structural hydroxyls. The initial and rapid exchange was characteristic, but to varying degrees, of all clay minerals used in this investigation. Except for tritium in Davidson clay, the data were not sufficient to show that additional exchange occurs beyond the first stage. The data suggest that isotopic exchange and fractionation of hydrogen isotopes in the clay-water system may be significant for some age-dating and water-tracing investigations where water flow is slow through some kinds of clays. For many investigations, however, this isotope effect is not important, because it is small compared with accuracies required of the data. As the tracer art progresses, it will become possible to apply isotope effect corrections to the data. (Carstea-USGS)
W70-03897

2H. Lakes

'SALT-BISCUITS' - A SPECIAL GROWTH STRUCTURE OF NaCl IN SALT SEDIMENTS OF THE TUZ GOLU ('SALT LAKE'), TURKEY,
Heidelberg Univ. (West Germany). Sediment Research Lab.
For primary bibliographic entry see Field 02K.
W70-03671

ULTRA-LOW VELOCITY MEASUREMENT IN A STRATIFIED RESERVOIR BY ISOTOPIC CURRENT METER,
Tennessee Valley Authority, Norris. Engineering Lab.
Rex A. Elder, and Svein Vigander.
In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 81-84, 1967. 4 p, 4 fig.

Descriptors: *Thermal stratification, *Radioactivity techniques, *Radioisotopes, *Reservoirs, *Tracers, Velocity, Iodine radioisotopes, Instrumentation, Current meters, Stratified flow, Flowmeters, Flow measurement, Flow rates.
Identifiers: *Fontana Reservoir, Isotopic current meter.

Field water velocity measurement techniques used in TVA's Fontana Reservoir are described. Thermal density stratification of a uniformly varying type occurs in this reservoir and results in the withdrawal occurring from a discrete layer rather than through the full depth. The velocities, which are in the neighborhood of from 0 to 0.10 ft/sec, are measured by means of an instrument that uses radioactive iodine as a tracer. This meter was developed by the Atomic Energy Commission's Division of Isotopic Development and is termed DWICA-1, for Deep Water Isotopic Current Analyzer. The instrument also measures the current direction. Use of the described technique permits in situ flow studies in thermally stratified reservoirs where very low velocities could hardly be made previously. (Carstea-USGS)
W70-03697

RESULTS OF LIMNOLOGICAL INVESTIGATIONS ON THE VALLEY RESERVOIRS IN THE MORAVA RIVER BASIN,
Brno Univ. (Czechoslovakia).
Milos Zelinka.
Acta sc nat Brno, 2 (12): 1-40, 1968. 24 tab, 3 fig, 124 ref.

Descriptors: *Reservoirs, Water quality, Temperature, Water utilization, Water resources, Water supply, Water development, Epilimnion, Hypolimnion, Bioindicators, Biological properties, Physiochemical properties, Irrigation, Recreation, Fishing.
Identifiers: Czechoslovakian reservoirs, Forecast of water quality.

The results of limnological investigations carried out in 1952-1964 on the valley reservoirs in the Morava River Basin (Czech.) are presented. Tables of average results indicate both the basic characteristics of water composition and the flows in

former investigations. The influence of temperature of water on the development of biological conditions and the exploitation rates of water (water-supply, irrigation, fish breeding) is discussed. The problem of evaluation and prognosis of water quality in newly constructed reservoirs is discussed. The reference includes reports of the Research Institute of Water Management in Brno (Czech.), summarizing data ascertained by investigations on the valley reservoirs in the Morava River Basin. A complete list of publications dealing with limnology of these reservoirs is also presented. (Novotny-Vanderbilt)
W70-03715

BACTERIAL POPULATION OF HUMIFIED LAKES (IN RUSSIAN),
Akademiya Nauk SSSR, Leningrad. Zoologicheskii Institut.
A. G. Rodina.
Mikrobiologiya, Vol 38, No 3, p 531-537, May-June 1969. 2 fig, 7 tab, 17 ref.

Descriptors: *Bacteria, *Population, *Lakes, *Dystrophic, Biological communities, Eutrophication, Oligotrophy, Yeasts, Azotobacter, Sulfur, Detritus, Surfaces, Actinomycetes, Iron, Productivity, Humic acids, Calcium, Hydrogen ion concentration, Color, Magnesium, Chemistry, Temperature, Carbon dioxide, Oxygen, Biochemical oxygen demand, Silica, Nitrogen, Organic matter, Depth, Bottom sediments, Hydrogen sulfide, Humus, Pseudomonas, Pigments, Beggiatoa, Clostridium.
Identifiers: *Humification, Lake Ladoga region (USSR), Mineralization, Spirilla, Physiological groups, Caulobacter, Rhodomicrobium vanielli, Thiothrix, Thiopedia, Chromatium, Rhabdochromatium, Beggiatoa alba.

The number of bacterial plankton in humified lakes of differing degrees of humification varies within wide limits: it is lower than in eutrophic lakes but appreciably higher than in oligotrophic lakes. Changes in water chemistry and bottom deposits, and especially the establishment of an acid pH, create special conditions in a humified lake for the cycle of matter, for the development of life in general, and for development of bacteria in particular. Low mineralization of water and acid pH assist the development of special bacterial associations and changes in bacterial populations, consisting of various physiological groups. Nonsporeforming rods predominate; the ratio of rods to cocci is quite close in all lakes. Sporeforming bacteria require a higher concentration of nutrients whereas many nonsporeforming bacteria extract nutrients from diluted solutions. The cenoses composition of humified lakes consists of many yeasts, filamentous forms and azotobacter-like cells in the bottom water layers, in the pelogen, and various sulfur bacteria on detritus particles and in surface layers of water. Actinomycetes was noted in Lake Naryadnoe and heterotrophic iron bacteria in Lake Solov-'enskoe, USSR. (Jones-Wisconsin)
W70-03948

AVAILABILITY OF MUD PHOSPHATES FOR THE GROWTH OF ALGAE,
For primary bibliographic entry see Field 05C.
W70-03955

CONCEPTS OF EUTROPHICATION AND TROPHIC BIOLOGY,
Oesterreichische Akademie der Wissenschaften, Vienna. Lunz Biological Station.
Franz Ruttner.
Fundamentals of Limnology, University of Toronto Press, p 130-131, 159-165, 1963. 2 fig.

Descriptors: *Lakes, *Eutrophication, *Biomass, *Productivity, Cyanophyta, Nuisance algae, Limnology, Chlorophyta, Plankton, Phytoplankton, Water pollution effects, Wisconsin Zooplankton, Tripton, Nannoplankton, Nutrients, Oligotrophy, Temperature, Light intensity, Daphnia, Connecticut, Rotifers.
Identifiers: *Concepts, *Trophic biology, Anabaena flos aquae, Aphanizomenon flos aquae, Gloeotrichia echinulata, Botryococcus, Plankton distribution, Wisconsin Lake Survey, Nitrogen content, Lake Erken (Sweden), Lake Mendota (Wis), Net plankton, Chlorophyll content, Centrifuge method, Calculated volume method, Cyclotella comensis, Rhodomonas lacustris, Enotomostraca, Diaptomids, Bosmina, Carinthia, Sunda Islands.

This standard textbook of limnology includes a discussion of concepts pertaining to eutrophication and trophic ecology of lakes. Mechanical factors influencing plankton distribution include density of water and plankton, differential water viscosity, and turbulent eddy diffusion currents. The following describes formation of nuisance blooms, 'In calm weather the blue-green algae of the plankton rise to the surface in consequence of their 'gas vacuoles' and there aggregate into thick masses, often forming a 'water bloom' recognizable from afar by its blue-green coloration. Anabaena flos aquae and Aphanizomenon flos aquae reveal by their names that they belong to the group of algae that can produce this striking phenomenon.' Based upon a composite definition by others, production can be considered as the total amount of organic matter, representing balance between assimilation and dissimilation, which forms in a defined period from raw materials supplied. Standing crop is defined as the instantaneous living population. Fertility is the average biomass of a unit volume of water within the trophogenic zone, and is governed by limiting nutrients, their conversion to organic matter occurring in proportion to temperature and illumination. Discussion includes a critique of techniques for determination of planktonic biomass. (Eichhorn-Wisconsin)
W70-03959

THE MYXOBACTERIA TYPE QUOTIENT AS AN INDICATOR OF EUTROPHICATION FOR SURFACE WATERS (IN GERMAN),
Erlangen-Nuremberg Univ. (West Germany). Hygienisch-Bakteriologischen Institut.
W. Graf, and P. Sturzenhofecker.
Archiv fur Hygiene und Bakteriologie, Vol 149, No 3/4, p 265-273, 1965. 2 fig, 4 tab, 13 ref.

Descriptors: *Eutrophication, *Myxobacteria, *Surface waters, *Indicators, Biochemistry, Ecology, Plankton, Oxygen, Organic matter, Nitrogen, Phosphorus, Calcium, Hydrogen ion concentration, Color, Mud, Catalysis, Pigments, Depth, Fish, Zooplankton, Sewage, Beaches, Sampling, Carbon dioxide.
Identifiers: *Sporocytophaga cauliformis, Uberlinger See (Germany), Biosphere, Transparency, Catalases, Swarming characteristic, Walchensee (Germany), Kochelsee (Germany), Antibiotic activities.

Aquatic mysobacteria, Sporocytophaga cauliformis, are common in surface waters. They are separable into two types, based on their biochemical properties: Type I can split sugar aided by acid without gas formation and shows strong catalase formation; Type II cannot form sugar from acid and shows a weak catalase activity. An extensive survey of their relative occurrence showed great differences, but ordinarily Type I prevailed about 75%; Type II increased in eutrophic waters. Research shows them as a microbiological indicator of trophication of surface waters. The ability to form catalases is the distinguishing characteristic of the types. A direct relationship between the eutrophication state and the type quotient exists with oxygen content a criterion for type distribution. Type I occurs in oxygen-rich media on the basis of its heavy catalase activity, whereas Type II, on the basis of its low ability to form catalases, grows in an oxygen-poor environment. In assuming that these differences also apply to growth in open water, we obtain direct relationships between the ecology of both types and the oxygen content of the corresponding biotope. (Jones-Wisconsin)
W70-03963

RX FOR AILING LAKES--A LOW PHOSPHATE DIET,
International Joint Commission-United States and Canada.

Environmental Science and Technology, Vol 3, No 12, p 1243-1245, 1969. 2 fig.

Descriptors: *Phosphates, *Lakes, *Detergents, *Tertiary treatment, *Great Lakes, Control, Costs, Eutrophication, Nitrates, Lake Erie, Lake Ontario, Pollution abatement, Oligotrophy, Depth, Phytoplankton, Zooplankton, Physicochemical properties, Domestic wastes, Sewage, Industrial wastes, Agriculture, St Lawrence River, Algae, Coliforms, Dissolved oxygen, Dissolved solids, Temperature, Color, Taste, Hydrogen ion concentration, Iron, Radioactivity.
Identifiers: Canada, Mesotrophy, Lake Norrviken, Lake Mendota, Lake Fures, Lake Sebasticook, Lake Washington, Lake Malaren, Lake Annecy, Lake Vanern, Lake Constance, Pfaffikersee, Turlersee, Baldeggersee, Greifensee, Zurichsee, Moses Lake, Hallwillersee.

Study was initiated in 1964 when the International Joint Commission of the U S and Canada established advisory groups on status of pollution in Lakes Erie and Ontario and segments of the St Lawrence River. Report recommends technical and legislative machinery for control measures. Detergents' phosphate content should be reduced immediately to minimum practical levels, with complete replacement of phosphorus with less innocuous substances no later than 1972. 80% removal of phosphates from all effluents should be effected by 1972 in the Lake Erie basin and by 1975 in Lake Ontario. Treatment of waste effluents for phosphate removal must be in addition to, not a substitute for detergent reformulation. Phosphorus and nitrogen are recognized as the major nutrients responsible for eutrophication; it is apparent that phosphate is the controlling factor in enrichment of lower Great Lakes. Efficient and relatively inexpensive methods are available for 80-95% removal of phosphorus during sewage treatment, whereas comparable elimination of nitrogen compounds is not yet feasible. Costs for phosphate removal at treatment plants would be reduced by one-half to two-thirds with replacement of phosphate detergent builders. (Jones-Wisconsin)
W70-03964

NITROGEN METABOLISM IN LAKES. I. MEASUREMENT OF NITROGEN FIXATION WITH N-15,
Wisconsin Univ., Madison. Dept. of Zoology; and Pittsburgh Univ., Pa. Dept. of Zoological Sciences.
John C. Neess, Richard C. Dugdale, Vera A. Dugdale, and John J. Goering.
Limnology and Oceanography, Vol 7, p 163-169, 1962. 3 fig, 1 tab, 10 ref.

Descriptors: *Nitrogen fixation, *Metabolism, *Lakes, *Analytical techniques, Nitrogen cycle, Wisconsin, Pennsylvania.
Identifiers: *Nitrogen-15, Mass spectrometry, Isotope ratios, Heavy nitrogen, Nitrogen (Kjeldahl), Isotope-ratio mass spectrometers, Lake Wingra (Wis), Lake Mendota (Wis), Pittsburgh (Pa), Error analysis.

Heavy nitrogen (N-15) has been successfully used in studies of nitrogen metabolism in organisms and of biological nitrogen fixation. A method is described for measuring rates of nitrogen fixation in lake water samples using N-15 as a tracer, and subsequent determination of isotope ratio by mass spectrometry of nitrogen fixed during incubation of sample. Details of gassing manifold; including special glassware, are described, as are procedures and reagents. Rates of nitrogen fixation can be calculated from a knowledge of Kjeldahl-nitrogen, determined after incubation, and of isotope enrichment of both starting nitrogen gas and the fixed sample. Selection of proper standards is crucial for accurate determination of aton % excess N-15 in fixed sample. Statistical comparisons of a series of blanks

and standards with a single bulb of compressed, water-pumped nitrogen gas--used as a primary standard--indicated that routine controls are not required and that ammonium sulfate is an adequate secondary standard. Probable sources of error include use of reduced nitrogen-pressure in incubation vessel, length of incubation, and incorporation of label into nitrate or nitrite (lost to the Kjeldahl determination). These errors are negligible in the procedure described. (Eichhorn-Wisconsin)
W70-03970

ONONDAGA LAKE, NEW YORK--AN UNUSUAL ALGAL ENVIRONMENT,
Syracuse Univ., N. Y. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05C.
W70-03974

EVIDENCE FOR EUTROPHICATION FROM REMAINS OF ORGANISMS IN SEDIMENTS,
Indiana Univ., Bloomington. Dept. of Zoology.
David G. Frey.
Eutrophication: Causes, Consequences, Correctives. Proceedings of a Symposium, National Academy of Sciences, Washington, DC, p 594-613, 1969. 8 fig, 28 ref.

Descriptors: *Eutrophication, *Sediments, Paleolimnology, Biochemistry, Algae, Cyanophyta, Mineralogy, Aquatic animals, Stratigraphy, Pollen, Spores, Diatoms, Meromixis, Carbon radioisotopes, Ecology, Silica, Epilimnion, Daphnia, Hypolimnion, Sewage effluents, Nutrients, Clays, Sedimentation rates, Oligotrophy, Glaciation.
Identifiers: *Remains, *Organisms, Fossils, Morphological fragments, Carotenoids, Cladocera, Langsee, Esthwaite water, Lago di Monterosi (Italy), Ambrosia, Community analysis, Zurichsee, Lake Washington, Phacotus, Difflugia, Ceratium, Dinobryon, Staurastrum, Baldeggersee, Oscillatoria, Codonella, Limmat River (Switzerland), Aguada de Santa Ana Vieja (Guatamala), Lake Petenxil (Guatemala), Diversity index, Equitability, Lake Sebasticook (Maine), Centric diatoms, Araphidineas.

'Remains of organisms' may mean both the biochemical substances produced by organisms or resulting from their degradation, and identifiable morphological fragments. Studies of biochemical fossils and the chemistry and mineralogy of sediments are preferable to studies of morphological reamins, since, with new methods and techniques, a close-interval stratigraphy can be constructed from a core only an inch or two in diameter. The most important morphological remains in freshwater sediments are pollen and spores (chiefly of terrestrial plants), diatom frustules and Cladoceran fragments. Pollen diagrams provide a relative chronology; appearance of Ambrosia pollen grains gives a stratigraphic horizon, dating incidence of man and his modification of regional ecology. Diatom remains reflect composition of producing populations; their assemblages in offshore sediment cores show progressive changes, interpretable in terms of the lakes' history and their relative abundance gives insight inot changes accompanying enrichment. Most abundant animal remains in sediments are heads and shells of various Cladocera and new techniques enable us to analyze Cladoceran population responses in greater detail. There are inconclusive indications that quantities of remains may be indicative of past productivity. (See also W70-03975). (Jones-Wisconsin)
W70-03977

SEDIMENT-WATER NUTRIENT INTERCHANGE,
Federal Water Pollution Control Administration, Corvallis, Oreg.
Arnold R. Gahler.
Proceedings of the Eutrophication-Biostimulation Assessment Workship, June 19-21, 1969, California Univ, Berkeley, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Ore, Pac Northwest Water Lab, p 243-257. 6 tab, 20 ref.

Descriptors: *Measurement, *Sediment-water interfaces, Nutrients, Algae, Aquatic plants, Ecosystems, Bacteria, Hydrogen ion concentration, Eutrophication, Suspension, Phosphorus, Phosphates, Nitrogen, Ammonia, Nitrites, Silicates, Nitrates, Conductivity, Oligotrophy, Oregon, California, Minnesota, South Dakota, Dredging, Time, Temperature, Freezing, Storage, Cobalt, Irradiation, Waves (Water), Wind, Fish, Boating, Gases, Diffusion.
Identifiers: *Interchange, Upper Klamath Lake (Ore), Agency Lake (Ore), Salton Sea (Calif), Selenastrum, Shagawa Lake (Minn), Sallie Lake (Miss), Herman Lake (S Dak), Clear Lake (Calif), Woahink (Ore), Interstitial water, Benthic organisms, Algal growth.

Quantitative measurement of nutrient interchange between sediments and overlying lake water is difficult either by field or laboratory tests. Nutrient availability in lake sediments was determined by analysis of interstitial water from sediments taken from Oregon lakes and others in western United States. Much soluble phosphorus and nitrogen is available for algal growth when sediment is physically mixed with overlying water. In shallow lakes, mixing occurs by resuspension of sediments from wave action, stirring by benthic organisms, fish, boating, gas release, lifting of sediment by algal growths, and diffusion. Cores indicate concentrations of nutrients in interstitial water at levels 2-6 feet below the sediment-water interface. This information may be useful in predicting value of dredging for lake restoration. Freezing and storage changes sediments; only fresh sediments give accurate determinations of soluble nutrients in interstitial water. Irradiation of sediments with cobalt for sterilization increased soluble orthophosphate and soluble organic compounds in interstitial water. Laboratory experiments indicate Upper Klamath Lake, Oregon, sediments promote algal growth and elimination of sediment nutrient release by additives forming hydrous oxides and insoluble phosphates indicate that this technique may provide only temporary lake restoration. (See Vol 3, No 7, Field 5C, entry W70-02775). (Jones-Wisconsin)
W70-03980

TRACE ELEMENT MEASUREMENTS IN THE AQUATIC ENVIRONMENT,
Washington State Univ., Pullman. Dept. of Sanitary Engineering.
William H. Funk, Surinder K. Bhagat, and Royston H. Filby.
Proceedings of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ, Berkeley, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Ore, Pac Northwest Water Lab, p 207-221. 6 fig, 3 tab, 30 ref.

Descriptors: *Trace elements, *Aquatic environment, Carbon radioisotopes, Algae, Neutron activation analysis, Gamma rays, Cyanophyta, Iron, Cobalt radioisotopes, Sodium, Irradiation, Manganese, Copper, Potassium radioisotopes, Zinc radioisotopes, Strontium radioisotopes, Uranium radioisotopes, Hypolimnion, Epilimnion, Thermocline, Diatoms, Radioisotopes, Scenedesmus.
Identifiers: Particulate matter, Micronutrients, Sodium iodide, Germanium, Washington, Columbia plateau, Aphanizomenon flos-aquae, Chromium radioisotopes, Scandium radioisotopes, Antimony radioisotopes, Rubidium radioisotopes, Thorium radioisotopes, Mercury radioisotopes, Barium radioisotopes, Bromium radioisotopes, Gallium radioisotopes, Lanthanum radioisotopes, Cladophora, Spirogyra, Fragilaria, Stephanodiscus.

Activation analysis appears suitable for direct study of the aquatic environment. Procedures developed could be initially utilized to survey lakes and streams to delimit the micronutrients available, simplifying tests for algal responses to additions of specific micronutrients (since it would be known which were abundant and which deficient); responses could then be measured by carbon-14 or other suitable methods. Speculation is impossible on nutritional requirements or trace element composition of algae tested because of the limited number of analyses made and difficulty in eliminating particulate matter adhering to algal cells. When enough data are gathered and procedures standardized, it may be possible to determine algal growth patterns that are directly related to either overabundance or lack of certain trace elements. It is possible that algae exerts a far greater influence on nutrition of a lake or stream than heretofore believed; they may act as flocculating agents in settling nutrients from the water and alternately take up and release metals, or act as chelating agents complexing many metals and keeping them in solution. (See Vol 3, No 7, Field 5C, entry W70-02775). (Jones-Wisconsin)
W70-03981

THE CLASSIFICATION OF LAKES,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
John R. Donaldson.
Proceedings of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ, Berkeley, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Ore, Pac Northwest Water Lab, p 171-185. 7 fig, 2 tab, 7 ref.

Descriptors: *Lakes, *Classification, Biota, Ecosystems, Oregon, Oligotrophy, Alkalinity, Dissolved solids, Hardness (Water), Temperature, Dissolved oxygen, Primary production, Depth, Phytoplankton, Growth rates, Fish, Foods, Zooplankton, Trophic level, Sockeye salmon, Nutrients, Physicochemical properties.
Identifiers: *Oregon lakes, Woahink Lake (Ore), Waldo Lake (Ore), Odell Lake (Ore), Crater Lake (Ore), Morphometry.

Grouping lakes on a regional basis is logical and the trophic nomenclature from oligotrophy to eutrophy is useful only in its broadest sense. Information was collected for Oregon lakes concerning abiotic and biotic conditions and punched onto cards. Density of a food resource is the result of the total output through production and the outflow through consumption and decomposition; thus, it becomes a real measure of changes in these rates or of environmental effects upon them. Production being the product of growth rate and biomass, a relationship is established between biomass and production. By defining relationships between nutrients and primary producers, production models can be developed allowing prediction of the effect of nutrient changes on consumer biomass. This relationship definition is advantageous in understanding the trophic process and providing useful information for the actual management of aquatic resources. Knowledge of density-dependent relations existing within a single lake, as well as among lakes, could significantly aid in establishing a meaningful lake classification scheme. Of greater import is the potential to plot trophic evolution of a lake through the biota instead of merely physically and chemically. (See Vol 3, No 7, Field 5C, entry W70-02775). (Jones-Wisconsin)
W70-03984

FACTORS INFLUENCING ALGAL PRODUCTIVITY IN DEER CREEK RESERVOIR, UTAH,
Utah Univ., Salt Lake City. Dept. of Zoology; and Iowa State Univ., Ames. Dept. of Sanitary Engineering.
Arden R. Gaufin, and Donald B. McDonald.
Transactions American Microscopical Society, Vol 84, p 269-279, 1965. 1 fig, 1 tab, 7 ref.

Descriptors: *Algae, *Primary productivity, *Utah, *Reservoirs, Limnology, Sampling, Plankton, Stratification, Silica, Diatoms, Chlorophyta, Temperature, Surface waters, Distribution, Bays, Ecology, Light intensity, Currents (Water), Geolo-

gy, Geographical regions, Shore-line cover, Carbonates, Dissolved oxygen, Hydrogen ion concentration, Carbon dioxide, Bicarbonates, Nitrates, Phosphates, Ammonia, Physicochemical properties, Sewage, Hypolimnion, Thermocline, Solar radiation, Aquatic plants, Periphyton, Photosynthesis, Cyanophyta, Nitrites, Zooplankton, Nutrients, Cycling nutrients, Chrysophyta.
Identifiers: *Deer Creek Reservoir (Utah), Provo River (Utah), Fragilaria capucina, Asterionella formosa, Stephanodiscus, Cyclotella, Wasatch County (Utah), Flagellates, Seasonal effects, Depth distribution.

Limnological studies (1957-1959) of Deer Creek Reservoir revealed well-defined chemical and thermal stratification during summer, terminating with autumnal overturn. Inflowing waters of the Provo River and seasonal changes were, seemingly, primary influences on chemical conditions; plankton pulses exerted a lesser effect, although silica concentrations were reduced during diatom blooms. Plankton distribution varied seasonally, and although species composition varied during the three years, a general pattern was evident within the reservoir. In winter, Fragilaria capucina, Asterionella formosa, Stephanodiscus, and, in 1959, Cyclotella predominated below the ice. In spring, diverse species of chlorophytes (green algae) appeared in response to recirculating and incoming nutrients. In surface samples, numbers of Asterionella, Stephanodiscus and other diatoms decreased as temperatures increased, and various chlorophytes became common. With autumnal overturn, Asterionella and Stephanodiscus reappeared at surface. Species of chlorophytes varied widely during three years, while predominant diatoms remained constant in 1957-1958. Many plankters were apparently relatively restricted to certain strata of water, but were often displaced by vertical currents. Horizontal distribution was irregular. Generally, open water of the reservoir supports a homogeneous algal flora somewhat different from those in shallow bays. (Jones-Wisconsin)
W70-03986

FLORIDA'S LAKES (PROBLEMS IN A WATER PARADISE),
For primary bibliographic entry see Field 06E.
W70-04013

2I. Water in Plants

YIELD-PROTEIN RELATIONSHIPS IN WHEAT GRAIN, AS AFFECTED BY NITROGEN AND WATER,
Nebraska Univ., Lincoln.
For primary bibliographic entry see Field 02G.
W70-03800

FUNCTIONS FOR COTTON (GOSSYPIUM HIRSUTUM L.) PRODUCTION FROM IRRIGATION AND NITROGEN FERTILIZATION VARIABLES: II. YIELD COMPONENTS AND QUALITY CHARACTERISTICS,
California Univ., Davis. Dept. of Water Science and Engineering; and California Univ., Davis. Dept. of Agronomy.
Donald W. Grimes, W. L. Dickens, and W. D. Anderson.
Agronomy Journal, Vol 61, No 5, p 773-776, Sept-Oct 1969. 3 tab, 3 fig, 16 ref.

Descriptors: *Crop response, *Cotton, *Irrigation efficiency, *Plant growth, *Nitrogen, Arid lands, California, Soil-water-plant relationships, Statistics, Crop production, Fibers (Plant).
Identifiers: *Production function, Plant quality.

Tests were conducted on 2 soils in the arid San Joaquin Valley of California to develop relationships of applied irrigation water and nitrogen to cotton yield components, plant height and fiber quality. Equations were developed relating plant height, flowers, bolls and lint quality to the amount of water applied for 3 levels of nitrogen. There was a positive correlation between yield and number of flowers and bolls. Plant height continued to increase with additional water, but beyond a certain point lint yield responded negatively. Fiber quality was primarily a function of water rather than nitrogen. (Crouse-Arizona)
W70-03805

FUNCTIONS FOR COTTON (GOSSYPIUM HIRSUTUM L.) PRODUCTION FROM IRRIGATION AND NITROGEN FERTILIZATION VARIABLES: I. YIELD AND EVAPOTRANSPIRATION,
California Univ., Davis. Dept. of Water Science and Engineering.
Donald W. Grimes, H. Yamada, and W. L. Dickens.
Agronomy Journal, Vol 61, No 5, p 769-773, Sept-Oct 1969. 2 tab, 6 fig, 13 ref.

Descriptors: *Arid lands, *Irrigation efficiency, *Cotton, *Plant growth, *Evapotranspiration, Clays, Loam, California, Economic efficiency, Nitrogen, Water utilization, Crop production, Crop response.
Identifiers: *Production function.

Water use efficiency for cotton (kg. of lint produced per cm. of water used in the evapotranspiration process) was studied on 2 soil types in the arid San Joaquin Valley of California. One type was clay loam and the other a fine sandy loam. Two inputs, irrigation water and nitrogen, were varied. Relative yield was expressed as a function of evapotranspiration with a regression equation. Increasing increments of water resulted in curvilinear yield responses on both soils for all levels of nitrogen. In both cases a maximum yield level was reached and beyond that additional water application resulted in reduced efficiency. Response to nitrogen was more marked on the sandy loam than the clay loam. Production functions are useful for technical crop management and for determining economic efficiency of inputs. (Crouse-Arizona)
W70-03806

ROOTZONE SALT PROFILES AND ALFALFA GROWTH AS INFLUENCED BY IRRIGATION WATER SALINITY AND LEACHING FRACTION,
Agricultural Research Service, Riverside, Calif. Soil and Water Conservation Research Div.; and Agricultural Research Service, Riverside, Calif. Salinity Lab.
For primary bibliographic entry see Field 02G.
W70-03807

INFILTRATION RATES AS AFFECTED BY DESERT VEGETATION,
Arizona Univ., Tucson.
For primary bibliographic entry see Field 02G.
W70-03864

2J. Erosion and Sedimentation

GAMMA-RAY SPECTROSCOPY AS A TOOL FOR A RAPID INVESTIGATION OF DETRITIC CORES,
Centre National de la Recherche Scientifique, Gif-sur-Yvette (France). Centre des Faibles Radioactivities.
For primary bibliographic entry see Field 07B.
W70-03650

EOLIAN MICRORIDGES ON MODERN BEACHES AND A POSSIBLE ANCIENT EXAMPLE,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 02L.
W70-03661

MOBILE-BED FLUVIOLOGY,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
T. Blench.
Edmonton, Canada, The University of Alberta Press, 1969. 168 p, 30 fig, 24 plate, 178 ref, 2 append.

Descriptors: *Open channel flow, *Bed load, *Sedimentation, *Erosion, *Regime, River flow, Silting, Sediment control, Streamflow, Sediment load, Civil engineering, Channel morphology, Hydraulic engineering, Hydraulic design, Hydraulic models, Hydraulic structures, Degradation (Stream).
Identifiers: *Mobile-bed hydraulics, Textbooks.

Mobile-bed hydraulics is discussed in a textbook intended for use in graduate courses and by professional civil engineers, hydraulic engineers, hydrologists, and water managers. Sediment transport, erosion, and sedimentation are examined from the viewpoint of self-adjustment after a disturbance of equilibrium. The first 5 chapters teach basic principles, illustrated by field cases, and warn against dangers in interference with field regime. Two chapters lay the theoretical base for analysis of regime and for hydraulic design. The remaining chapters develop approximate practical applications of the basic equations. The design and research uses of hydraulic and mathematical models are given. (Knapp-USGS)
W70-03669

THE INFRA-RED DETERMINATION OF QUARTZ IN SEDIMENTS AND SEDIMENTARY ROCKS,
Liverpool Univ. (England). Dept. of Oceanography.
For primary bibliographic entry see Field 07B.
W70-03678

DEVELOPMENT OF A RADIOISOTOPE GAGE FOR MONITORING SEDIMENT CONCENTRATION IN RIVERS AND STREAMS,
Panametrics, Inc., Waltham, Mass.
For primary bibliographic entry see Field 07B.
W70-03687

SOME PROPOSALS OF THE STOCHASTIC METHOD OF FORECASTING FOR DEPOSITS IN RESERVOIRS,
Osaka Univ. (Japan). Dept. of Civil Engineering.
Akira Murota.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 49, p 376-383, 1967. 8 p, 4 fig, 2 tab.

Descriptors: *Reservoir silting, *Statistical methods, *Sedimentation, Landslides, Stochastic processes, Sediment transport, Probability, Mass wasting, Markov processes, Queueing theory, Rainfall, Forecasting.
Identifiers: Landslide probability, Landslide forecasting.

Usually forecasts of reservoir sedimentation have been made conventionally by using some empirical values of expected annual deposits. Because the debris yield is directly transported into the reservoirs at the upper reach of a river, the inflow rate of debris into the reservoirs would be highly related to the occurrence of mass movement. Heavy rains may be the prime trigger of mass movements, and may be treated by probability methods. After establishing probability distribution of the debris inflow, every state of the deposition processes, which would be considered as stochastic sequences, may be numerically calculated by means of the queueing theory under the assumption that each stage is a Markoff process. Numerical calculations are given for the Koyadaira basin at the Kurobe reservoir in northern Japan. (Knapp-USGS)
W70-03709

SEDIMENT YIELDS FROM THE CENTRAL COLORADO SNOW ZONE,
Forest Service (USDA) Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
Charles F. Leaf.
Journal of the Hydraulics Division, Proceedings of ASCE, Vol 96, No HY1, p 87-93, Jan 1970. Proc Paper 7006.

Descriptors: *Sediment yield, *Watershed management, *Water-yield improvement, Erosion, Eronsion control, Sediment discharge, Sediment rates, Sedimentation, Sediments, Trap efficiency, Cutting management, Colorado.
Identifiers: *Experimental watersheds.

To determine the effects of roads and forest-cover changes on sediment yields, measurements were made on one carefully logged and two undisturbed watersheds in the Fraser Experimental Forest, Colorado. Annual sediment yield averaged 200 pounds per acre immediately following road construction in 1950-52 and logging in 1954-56. In the period 1958-66 sediment yield averaged 43 pounds per acre, despite an estimated 25 percent increase in annual runoff caused by the harvest, compared with yields of 11 and 21 pounds per acre on the undisturbed watersheds.
W70-03821

EROSION OF CIRQUES,
North Carolina Univ., Chapel Hill. Dept. of Geology.
William A. White.
Journal of Geology, Vol 78, No 1, p 123-126, Jan 1970. 4 p, 2 fig, 1 plate, 10 ref.

Descriptors: *Erosion, *Cirques, *Glaciers, Topography, Geomorphology, Ice, Scour.
Identifiers: Cirque erosion, Alpine glaciers, Degradation (Glacial).

It is suggested that cirques are formed by deepening through glacial erosion on their floors rather than by headward sapping on their walls. This idea is supported by: (1) dovetailing or interfingering of cirques on opposite sides of narrow aretes; (2) crater cirques that occupy the entire top of individual mountains; and (3) the rarity of cols and greater rarity of passes in narrow aretes. (Knapp-USGS)
W70-03846

CONSTRAINED RANDOM WALK MEANDER GENERATION,
IBM Watson Research Center, Yorktown Heights, N.Y.
For primary bibliographic entry see Field 02E.
W70-03866

AN ERROR FUNCTION DESCRIPTION OF THE VERTICAL SUSPENDED SEDIMENT DISTRIBUTION,
Agricultural Research Service, Oxford, Miss. Sedimentation Lab.
Joe C. Willis.
Water Resources Research, Vol 5, No 6, p 1322-1329, Dec 1969. 8 p, 6 fig, 1 tab, 3 ref.

Descriptors: *Suspended load, *Mathematical models, *Sediment distribution, Laboratory tests, On-site tests, Diffusion, Dispersion, Model studies, Sediment transport.
Identifiers: Error function distributions.

A new model for the vertical distribution of suspended sediment, which has the form of an error or Gaussian distribution function, agrees with the classical model in the central flow region and has a major advantage in that its integral over the flow depth converges to a consistent estimate of the measured average sediment concentration. The average concentrations predicted by the model compare favorably with concentrations derived from sediment load measurements in both the laboratory and the field. The theoretical diffusion coefficient distributions associated with classical and error function models are also similar. (Knapp-USGS)
W70-03873

UNIFICATION OF DATA ON SEDIMENT TRANSPORT IN FLUMES BY SIMILITUDE PRINCIPLES,
Agricultural Research Service, Oxford, Miss. Sedimentation Lab.
Joe C. Willis, and Neil L. Coleman.
Water Resources Research, Vol 5, No 6, p 1330-1336, Dec 1969. 7 p, 5 fig, 2 tab, 17 ref.

Descriptors: *Sediment transport, *Hydraulic models, *Hydraulic similitude, Simulation analysis, Model studies, Laboratory tests, Mathematical models, Mathematical studies, Open channel flow, Suspended load, Bed load.
Identifiers: Similitude analysis.

Similitude criteria for flow with sediment transport are derived by normalizing equations of continuity and motion for flow in an alluvial channel. The well-known Reynolds and Froude numbers are obtained as well as a transport similitude number that prescribes the sediment effects on the inertial, gravitational, and viscous forces acting in the flow system. The Froude number along with a similitude number for the median diameter of the sediment particles is found to specify transport similitude for various flume investigations. A unified correlation of sediment discharge data from numerous laboratory flume studies is developed through the similitude analysis. (Knapp-USGS)
W70-03874

2K. Chemical Processes

'SALT-BISCUITS' - A SPECIAL GROWTH STRUCTURE OF NaCl IN SALT SEDIMENTS OF THE TUZ GOLU ('SALT LAKE'), TURKEY,
Heidelberg Univ. (West Germany). Sediment Research Lab.
German Muller, and Georg Irion.
Journal of Sedimentary Petrology, Vol 39, No 4, p 1604-1607, Dec 1969. 4 p, 5 fig, 4 ref.

Descriptors: *Chemical precipitation, *Sodium chloride, *Salts, *Lakes, *Water chemistry, Sediments, Evaporation, Surface waters, Sedimentation, Particle shape.
Identifiers: *Turkey, Tuz Golu (Salt Lake).

Biscuit-shaped NaCl disks are the main constituents of a special sediment type in evaporating Tuz Golu, Turkey. Their origin can be observed directly: thin salt flakes grow in the surface water layer of the basin and settle down. After deposition they continue growing in all directions, larger NaCl crystals developing at the bottom, smaller ones on the top of the disks. (Gabriel-USGS)
W70-03671

STABILITY OF CALCIUM CARBONATE POLYMORPHS IN WARM, SHALLOW SEAWATER,
Brown Univ., Providence, R.I.
H. Dale Winland.
Journal of Sedimentary Petrology, Vol 39, No 4, p 1579-1587, Dec 1969. 9 p, 3 fig, 2 tab, 16 ref.

Descriptors: *Calcium carbonate, *Sea water, *Shallow water, Magnesium, Calcite, Ions, Chemical analysis, Water chemistry, Magnesium carbonates, Sediments, Limestones, Recent epoch, X-ray analysis, Stability, Energy, Trace elements.
Identifiers: British Honduras Shelf, Bahama Bank, Calcium carbonate stability.

Skeletal elements originally high Mg calcite are recrystallized to aragonite in Recent marine carbonate sediments. An explanation is proposed based on the stability of the calcium carbonate polymorphs. The stability fields defined for calcite and aragonite from experimentation with pure minerals in distilled water should not be projected unmodified into the marine environment because ions other than calcium can substitute for calcium in their crystal structures. A condition of equilibrium between coexisting crystalline calcium carbonate and seawater can be reached only if the distribution of major and minor ions between the separate phases is in equilibrium. Aragonite in equilibrium with seawater should contain about 0.9 mol % Sr and have a free energy of formation of about -269.5 kcal/mol. Calcite in equilibrium with seawater should contain about 10 mol % Mg and have a free energy of formation of about -267.0 kcal/mol; therefore low Mg calcite is not in equilibrium with seawater in shallow marine environments. Of the impure polymorphs, aragonite has the lower free energy of formation and should be the thermodynamically stable form in shallow marine environments. Partition and stability information show that marine carbonate sediments cannot undergo diagenesis to normal limestones, containing 1 to 3 mol % Mg, in marine water. (Garbiel-USGS)
W70-03672

HURRICANE TRITIUM I: PRELIMINARY RESULTS ON HILDA 1964 AND BETSY 1965,
Miami Univ., Fla. Inst. of Marine Science.
For primary bibliographic entry see Field 02B.
W70-03693

APPLICATION OF DEUTERIUM ANALYSES TO THE HYDROLOGY OF THE LAKES OF THE GRAND COULEE, WASHINGTON,
Geological Survey, Denver, Colo.; and Woods Hole Oceanographic Institution, Mass.
Irving Friedman, and Alfred C. Redfield.
In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 77-80, 1967. 4 p, 1 fig.

Descriptors: *Deuterium, *Lakes, *Heavy water, *Tracers, *Radioactivity techniques, Washington, Evaporation, Freezing, Water sources, Water chemistry, Surface waters, Canal seepage, Water balance, Reservoirs, Inflow, Streams, Groundwater, Hydrogeology.
Identifiers: *Grand Coulee (Wash).

The heavy isotopic forms of water, HDO and water containing O-18 occur in natural waters and can serve as natural tracers. Changes in deuterium content take place by freezing or evaporation. The probable sources of water pumped from the ground can be identified by measuring deuterium and ionic composition. Change in concentration of deuterium by evaporation follows different laws than does the change in ionic content. The hydrology of a series of lakes that occupy the abandoned gorge of the Columbia River was studied by isotopic analysis. Deuterium analysis shows that the upper lakes, Park and Blue, receive over 90% of their water from upstream surface inflow. Soap Lake is fed mainly by irrigation canal leakage, and a little seepage from another lake. Simultaneous equations for the balance of water, deuterium and salt were used to estimate the character and quantity of inflow and outflow from natural water reservoirs. (Carstea-USGS)
W70-03696

A BATTERY POWERED PROPORTIONAL STREAM WATER SAMPLER,
Forest Service (USDA), Corvallis, Oreg. Pacific Northwest Forest and Range Experiment Station.
For primary bibliographic entry see Field 07B.
W70-03856

THERMO-OSMOSIS THROUGH COMPACTED SATURATED CLAY MEMBRANES,
Gulf Research and Development Co., Pittsburgh, Pa.
For primary bibliographic entry see Field 02G.
W70-03859

REGIONAL VARIATIONS OF RIVER WATER COMPOSITION RESULTING FROM HALITE SOLUTION, MACKENZIE RIVER DRAINAGE BASIN, CANADA,
Research Council of Alberta, Edmonton; Calgary Univ. (Alberta); and Dept. of Energy, Mines and Resources, Calgary (Alberta). Inland Waters Br.
Brian Hitchon, A. A. Levinson, and S. W. Reeder.
Water Resources Research, Vol 5, No 6, p 1395-1403, Dec 1969. 9 p, 3 fig, 1 tab, 28 ref.

Descriptors: *Water quality, *Water chemistry, *Leaching, *Saline water, Saline water systems, Chlorides, Brines, Groundwater movement, Runoff, Infiltration, Overland flow.
Identifiers: Halite, Mackenzie River (Canada).

The composition of surface waters in the Mackenzie River drainage basin falls into three general groups: (1) rivers entering the Slave-Mackenzie system from the west which have total dissolved solids of 100-200 mg/l and chloride in the range less than 1 mg/l in their headwaters to 2-5 mg/l at their mouths; (2) surface waters on the Canadian Shield which have lower total dissolved solids (less than 100 mg/l) and chloride (less than 1 mg/l); and (3) the Slave and Mackenzie rivers and the Great Bear and Great Slave lakes, which have total dissolved solids 100-200 mg/l and chloride 5-10 mg/l. Cross sections with evidence of solution collapse structures and anomalous depositional thicknesses indicate extensive solution of Middle Devonian halite and movement of the resulting brines to discharge areas near the Slave River. Chemical and isotopic analysis of saline springs in the discharge area show an origin by solution of halite (and gypsum) by meteoric water. (Knapp-USGS)
W70-03860

DIEL AND SEASONAL VARIATIONS IN PHYSIOCHEMICAL LIMNOLOGY, SPEED RIVER, ONTARIO,
Guelph Univ. (Ontario).
John R. M. Kelso, and Hugh R. MacCrimmon.
Water Resources Research, Vol 5, No 6, p 1388-1394, Dec 1969. 7 p, 4 fig, 1 tab, 11 ref.

Descriptors: *Water chemistry, *Water quality, *Diurnal, *Biochemistry, Limnology, Rivers, Trace elements, Ammonia, Chlorides, Nitrates, Silica, Phosphates, Sulfates, Hydrogen ion concentration, Dissolved oxygen.
Identifiers: *Canada, *Speed River (Ontario).

Diel pulses occurred in pH, dissolved oxygen, and free carbon dioxide in Speed River, Ontario. Iron and fluoride levels were stable. Total alkalinity, silica, and turbidity levels varied, but not significantly. Wide diel ranges existed in ammonia, chloride, nitrate, nitrite, orthophosphate, sulfate, and specific conductance levels. High hexavalent chromium levels (0.57 mg/l) occurred only on one occasion. Diel means of these characteristics showed seasonal change fitting the seasonal trends evident during the year of observation. The nature and extent of diel variation are generally required to determine an effective procedure for examination of local changes in limnologic conditions. (Knapp-USGS)
W70-03861

A WORKING MODEL FOR THE VARIATION IN STREAM WATER CHEMISTRY AT THE HUBBARD BROOK EXPERIMENTAL FOREST, NEW HAMPSHIRE,
Dartmouth Coll., Hanover, N.H.; Yale Univ., New Haven, Conn.; Geological Survey, Washington, D.C.; and Forest Service (USDA), Durham, N.H.
Noye M. Johnson, Gene E. Likens, F. H. Bormann, D. W. Fisher, and R. S. Pierce.
Water Resources Research, Vol 5, No 6, p 1353-1363, Dec 1969. 11 p, 4 fig, 5 tab, 17 ref. NSF Grants GB1144, GB4169, GB6757, and GB6742.

Descriptors: *Water chemistry, *Water quality, *Small watersheds, *Surface-groundwater relationships, *Rainfall-runoff relationships, New Hampshire, Demonstration watersheds, Leaching, Mixing, Solutes, Aqueous solutions, Infiltration, Base flow, Seepage, Streamflow, Bank storage.
Identifiers: Hubbard Brook Experimental Watershed (N H).

Stream water chemistry varies hyperbolically with stream discharge through four decades of discharge change within the Hubbard Brook Experimental Forest, New Hampshire. This dilution process is most simply explained by the mixing of rain water or surface water with deeper soil water. The resultant mixture of waters subsequently appears as stream water. Sodium and silica concentrations in stream water are markedly diluted during high discharge periods while hydrogen ion, aluminum, and nitrate concentrations are increased. Magnesium, calcium, sulfate, chloride and potassium concentrations are changed very little by stream discharge variations. During the summer, biologic activity measurably reduces the concentration of nitrate and potassium in stream water. (Knapp-USGS)
W70-03867

IRON IN NATURAL WATERS--ITS CHARACTERISTICS AND BIOLOGICAL AVAILABILITY AS DETERMINED WITH THE FERRIGRAM,
Minnesota Univ., Minneapolis. Limnological Research Center.
Joseph Shapiro.
Verhandlungen der Internationalen Vereinigung fur theoretische und angewandte Limnologie, Vol 17, p 456-466, 1969. 15 fig, 1 tab, 5 ref.

Descriptors: *Bioassay, *Iron, Hydrogen ion concentration, Inorganic compounds.
Identifiers: *Ferrigram (Histogram), EDTA, Ethylenediaminetetraacetate, Fingerprint technique, Ferric iron, Potassium thiacynate, Optical density.

Ferric iron of surface waters was permitted to react with potassium thiocyanate (KSCN) at pH values ranging from 4.0 to 0.5. The results were expressed in the form of a histogram, called ferrigram. Depending on the nature of water, increase in reactability of iron with KSCN was either at higher or lower pH values thus rendering 'right-handed' and 'left-handed' ferrigrams. A mixture of two waters produced racemic results approaching arithmetic average. Addition of ethylenediaminetetraacetate (EDTA) increased the reactivity of iron in more acid solutions. Bioassay employing Microcystis aeruginosa and Gloeotrichia echinata indicated that availability of iron is related to the shape of the ferrigram. The ferrigram is a useful tool for empirical fingerprinting of iron in natural waters. (Wilde-Wisconsin)
W70-03954

PRINCIPLES OF PRIMARY PRODUCTIVITY: PHOTOSYNTHESIS UNDER COMPLETELY NATURAL CONDITIONS,
Bowling Green State Univ., Ohio. Dept. of Biology.
Jacob Verduin.
Algae and Man (Jackson, D F, editor) Plenum Press, N Y, p 221-238, 1964. 3 fig, 3 tab, 6 ref.

Descriptors: *Primary productivity, *Photosynthesis, *Environmental effects, Respiration, Ponds, Phytoplankton, Limiting factors, Physiological ecology, Carbon dioxide, Phosphorus, Nitrogen, Iron, Nutrients, Aquatic habitats, Light, Hydrogen ion concentration, Pennsylvania, Euglena, Lakes, Lake Erie, Michigan, Analytical techniques, Oxygen.
Identifiers: *Photobiology, *Chemical processes, Glenodinium, Trachelomonas, Predictive equations, Ceratium, Baule-Mitscherlich equation, Thiel College (Pa), Ulva lactuca, Algal populations, Differential titration, Lambert-Beer law, Suspensoid concentrations, Winkler technique, Community metabolism, Young's Pond (Pa), Brown's Pond (Pa), West Lost Lake (Mich), Maumee River, Ohio River, Pymatuning Reservoir (Pa).

Individual determinations of primary productivity vary widely, both spatially and temporally. Simper methods for determining such rates, permitting acquisition of many data, are preferable to more precise, but time-consuming techniques. Studies under completely natural conditions are desirable because in bottled samples, surface effects yield erroneous values for both photosynthesis and respiration. Community metabolism can be assessed by measuring, over short intervals, changes in dissolved oxygen by Winkler's techniques, and changes in concentration of carbon dioxide by differential titration. Estimates of hourly photosynthetic rates per microliter of phytoplankton, determined thus for two small ponds, are in good agreement with data reported in the literature. Analysis of photosynthetic yields, based on theoretical considerations and on the Baule-Mitscherlich equation for limiting factors, suggests that, among physical, chemical, and biotic factors, several factors can simultaneously limit photosynthetic yield. Substantial reduction of optimal yield is probably the rule in aquatic environments. The Lambert-Beer's law, describing attenuation of light in water, can be modified by adding an exponential term for concentration of light-adsorbing particulates. Several applications of the resultant equation to aquatic environments are recommended for further study. (See Vol 2, No 19, Field 5C, entry W69-07832). (Eichhorn-Wisconsin)
W70-03965

2L. Estuaries

EOLIAN MICRORIDGES ON MODERN BEACHES AND A POSSIBLE ANCIENT EXAMPLE,
Geological Survey, Menlo Park, Calif.
Ralph E. Hunter.
Journal of Sedimentary Petrology, Vol 39, No 4, p 1573-1578, Dec 1969. 6 p, 5 fig, 17 ref.

Descriptors: *Sedimentary structures, *Beaches, *Sands, Winds, Wind velocity, Geology, Waves (Water), Ripple marks, Particle size, Sandstones.
Identifiers: Eolian microridges.

Eolian microridges consist of a series of anastomosing ridges less than 1 cm in wave length. Eolian microridges have been observed to form where sand was being blown in saltation across wet sand surfaces, mostly on beaches. The ridges and intervening troughs are oriented transversely to wind direction and commonly have several types of asymmetry by which the direction of the wind that formed them can be determined. The structure may be distinguished from ordinary ripples of unusually small wave length by several criteria other than wave length. Eolian microridges are potentially preservable and structures found on several bedding planes of the Keefer Sandstone (Middle Silurian) near Lewistown, Pennsylvania, are possibly preserved examples. These structures, together with other evidence, strongly suggest a beach environment for this sandstone. (Gabriel-USGS)
W70-03661

STABILITY OF CALCIUM CARBONATE POLYMORPHS IN WARM, SHALLOW SEAWATER,
Brown Univ., Providence, R.I.
For primary bibliographic entry see Field 02K.
W70-03672

THERMAL CIRCULATION ON A ROTATING SPHERE; WITH APPLICATION TO THE OCEANIC THERMOCLINE,
Harvard Univ., Cambridge, Mass.; and Stockholm International Meteorological Inst. (Sweden).
A. R. Robinson, and Pierre Welander.
Journal of Marine Research, Vol 21, No 1, p 25-38, 1963. 2 fig, 4 ref.

Descriptors: *Model studies, *Mathematical model, *Stratification, *Thermocline, *Thermal stratification.

A mathematical model was developed of the thermal boundary layer beneath the surface of a differentially heated fluid portion of a rotating sphere, i.e., a region in which thermal conductivity is important but viscosity is negligible. A convective circulation in the rotating self-gravitating sphere is induced by prescribing a distribution of temperature on the free surface and a lower, constant temperature on the bottom. The motion is assumed to be laminar and steady. A general three dimensional similarity transformation is performed, and features of the related temperature and flow fields are studied. It was found that an upwelling of cold water into the boundary layer region from below is always necessary, that horizontal advection of heat is relatively negligible, and that a strong relation exists between boundary layer depth and surface forcing function. The solutions are examined for numbers characteristic of the main oceanic thermocline. (Guerrero-Vanderbilt)
W70-03725

NOTES ON THE THEORY OF THE THERMOCLINE,
New York Univ., Bronx. Dept. of Meteorology and Oceanography.
Robert Blandford.
Journal of Marine Research, Vol 23, No 1, p 18-29, 1965. 4 ref, 4 fig.

Descriptors: *Thermocline, *Diffusion, *Heat balance, *Convection, Thermal stratification.
Identifiers: Ekman layer.

An exact analytical solution is closed form for a steady, laminar model of the oceanic thermocline is presented. The model includes vertical diffusion and horizontal and vertical convection of heat. The solution satisfies boundary conditions that are in fair agreement with observation over the range of latitude of 10 deg to 45 deg. The behavior of the solution is given as a function of the imposed temperature and vertical velocity component at the bottom of the Ekman layer. A typical result of the analysis is that, as the surface temperature increases, the thermocline depth decreases, and the deep vertical velocity component increases. Subpolar gyres are shown to be excluded for some boundary conditions. The equations solved numerically by Stommel and Webster are shown to be exact and a derivation of Robinson's equations for an equatorial thermal regime is given. (Guerrero-Vanderbilt)
W70-03726

ON THE ROLES OF VERTICAL VELOCITY AND EDDY CONDUCTIVITY IN MAINTAINING A THERMOCLINE,
Washington Univ., Seattle. Dept. of Oceanography.
Roy Overstreet, and Maurice Rattray, Jr.
Journal of Marine Research, Vol 27, No 2, p 172-190, 1969. 9 fig, 19 ref.

Descriptors: *Mathematical model, *Thermocline, *Heat balance, Thermal stratification.
Identifiers: *Eddy coefficient, *Mass transport.

A model was developed of the permanent thermocline from a simplified heat balance equation in which the horizontal advection and conduction of heat have been neglected. Steady state solutions describing the general features of the temperature distributions associated with both divergent and convergent Ekman layers have been obtained for various distributions of vertical velocity and eddy conductivity. Some conclusions were: (1) Given a constant eddy coefficient, deep thermoclines can occur only in regions of Ekman convergence. (2) For divergent Ekman transport, a mixed layer can be modeled with an eddy coefficient that decreases with depth. (3) A variable eddy coefficient has an apparent advective effect. (4) Two of the solutions agree with observations in regions having respectively divergent and convergent Ekman mass transport. (Guerrero-Vanderbilt)
W70-03730

ON THERMALLY MAINTAINED CIRCULATION IN A CLOSED OCEAN BASIN,
Harvard Univ., Cambridge, Mass.
P. P. Niiler, A. R. Robinson, and S. L. Spiegel.
Journal of Marine Research, Vol 23, No 3, p 222-230, 1965. 4 fig, 3 ref.

Descriptors: *Mathematical model, *Thermocline, *Circulation, Thermal stratification.
Identifiers: *Thermohaline.

A three dimensional model was developed of a thermohaline-maintained circulation for a closed basin of finite depth on the beta plane. Diffusive processes were neglected and hence allow no interchange of momentum or heat with the region above the thermocline. The quasilinear, and quasigeostrophic, three dimensional problem was solved for the case of a semicircular basin of constant depth, where the potential vorticity is conserved in a relatively simple manner. The circulation, which conserves potential vorticity, consists of a wastward drift at all levels in the open ocean and a return flow that is accomplished in a swift eastward flowing current. A comparison was made to Worthington's paper on water mass analysis of deep circulation in the North Atlantic Basin. (Guerrero-Vanderbilt)
W70-03732

SUBMERGENCE EFFECTS ON A RHODE ISLAND BARRIER AND LAGOON AND INFERENCES ON MIGRATION OF BARRIERS,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
William P. Dillon.
Journal of Geology, Vol 78, No 1, p 94-106, Jan 1970. 13 p, 8 fig, 34 ref.

Descriptors: *Beaches, *Sedimentation, *Erosion, *Rhode Island, Waves (Water), Currents (Water), Provenance, Sediment transport, Sands, Beach erosion, Coasts, Deposition (Sediments), Geomorphology, Littoral drift, Surf, Silts, Tides, Vegetation effects.
Identifiers: Cape Cod (Mass).

The Charlestown-Green Hill barrier beach-lagoon complex lies along Rhode Island's south shore. Barrier beach and tidal delta sands, lagoonal fine sediments, and lag deposits have been deposited on a base of glacial till, outwash, and glaciofluvial sand. The beach and lagoonal sediments have been derived mainly from reworking of glacial sediments. Tidal currents have built a sand delta at the inshore end of an inlet, but sand on the barrier beach's lagoonal side has been introduced over the barrier. Fine sediments are deposited in the deepter areas of the lagoon. The barrier beach was formed at a lower sea level, and moved landward as the sea transgressed, with lagoonal deposition migrating with the barrier. The small size of this barrier places its base at a shallow depth, resulting in erosion of the entire seaward side by storm waves and also permitting considerable transport of sand across the barrier to the lagoon side. The barrier has remained small because of lack of sand supply. Thus lack of sand supply seems to be the dominant factor in allowing the landward migration of this barrier. (Knapp-USGS)
W70-03847

COMPUTER STUDIES OF FINITE-AMPLITUDE WATER WAVES,
Stanford Univ., Calif. Dept. of Civil Engineering.
For primary bibliographic entry see Field 07C.
W70-04009

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

OPERATION OF SEA WATER DISTILLATION PLANTS,
Office of Saline Water, Washington, D.C. Test and Evaluation Branch.
Robert H. Evans.
Journal of American Water Works Association, Vol 61, No 12, p 663-666, Dec 1969. 4 p, 4 fig.

Descriptors: *Desalination plants, *Efficiencies, *Water cost, Water supply, Water treatment, Distillation, Capital costs, Construction costs, Maintenance costs, Operating costs.
Identifiers: *Desalination costs.

Operating expenses, water costs, plant availability, and life of desalination plants are briefly reviewed. Prior to 1962 the desalting industry built plants which operated at very low performance ratios (water produced/Btu input). Most plants operated at between 5 and 7 lb of water/1,000 Btu, below 185 deg F brine temperature, and generally used polyphosphates for scale control. These plants were generally small and produced relatively high cost water in areas with no alternative source of water. OSW distillation plants, as illustrated by Freeport and Pt. Loma, were operating at performance ratios of about 10 in 1963. With the new Clair Engle Plant design, the performance ratio was raised to 20 and in future hybrid plants it is expected to be of the order of 25. OSW increased operating temperatures to 250 deg F using acid for scale control. In the last 3 years processing capability has passed 250 mgd. The largest commercial installation in the United States, the Westinghouse 2.62-mgd multistage flash unit at Key West, Fla, cost $4,056,000; it occupies 3.3 acres; and produces water at $0.86/1,000 gal. It has been onstream over 90% and is extremely successful. (Knapp-USGS)
W70-03657

DEVELOPMENT OF MATHEMATICAL MODEL AND COMPUTER PROGRAM FOR OPTIMIZATION OF VERTICAL TUBE EVAPORATOR SALINE WATER PLANTS,
Houston Research Inst., Inc., Tex.
A. E. Dukler, C. J. Huang, and M. L. Lee.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $2.25. Office of Saline Water Research and Development Progress Report No 404, Feb 1969. 164 p, 16 fig, 2 tab, 8 ref, 9 append. OSW Contract No 14-01-0001-657.

Descriptors: *Mathematical models, *Computer programs, *Desalination processes, *Desalination plants, Evaporators, Simulation analysis, Capital costs, Operating costs, Optimization, Dynamic programming, Systems analysis.
Identifiers: *Vertical tube evaporator desalting plant, Multistage evaporator process simulation, Fortran.

Techniques and mathematical models were developed for an optimum design of a VTE desalting plant. The optimization system is then programmed into an electronic computer which automatically searches and arrives at an optimum design. The computer program, as it results, is very flexible and versatile. The complete system is divided into 4 major subsystems which are Multistage Evaporator Process Simulation, Engineering Design Simulation, Capital and Operating Cost Calculation, and Optimum Searching Techniques. The Engineering Design Simulation and the Capital and Operating Cost Calculation are based on the design concept of a multistage evaporator system

arranged into the concentric geometric configuration. Modification of these subsystems for other geometrical arrangements can be accomplished readily and with little difficulty. Instructions are given for preparing the input data cards as well as operating the system. The source program is written in Fortran IV. (Carstea-USGS)
W70-03665

IMPROVED ANIONIC MEMBRANES FOR ELECTRODIALYSIS,
Monsanto Research Corp., Dayton, Ohio.
I. O. Salyer, E. V. Kirkland, and P. H. Wilken.
Office of Saline Water Research and Development Progress Report No 483, Dec 1969. 43 p, 11 fig, 14 tab. OSW Contract No 14-01-0001-1769.

Descriptors: *Membranes, *Desalination process, *Ion exchange, *Electrodialysis, Ammonium compounds, Hydrolysis, Saline water, Brackish water, Films, Research and development.
Identifiers: *Anionic membranes, Copolymenzation, Methyl iodide.

The preparation of aliphatic anion exchange membranes composed of ethylene-tri-methyl vinyl ammonium chloride copolymer involves four major steps: (1) copolymerization of ethylene and N-vinyl phthalimide, (2) film formation, (3) hydrolysis to ethylene-vinyl amine copolymer, and (4) quaternization with methyl iodide. It was found that di-t-butyl peroxide was an efficient initiator of the copolymerization reaction. The charge ratio was used to control the ratio of monomer in the copolymer products. The membranes were prepared by pressing the material between hot plates in a hydraulic press. Hydrolysis has been accomplished with hydrazine hydrate at temperatures below the reflux temperature. The experimental membranes have been compared with commercial membranes by means of several accepted screening tests. (Carstea-USGS)
W70-03666

RESEARCH AND DEVELOPMENT ON LOW PRESSURE REVERSE OSMOSIS MEMBRANES AND DESIGN OF A SMALL UNIT FOR BRACKISH WATER,
Dartmouth Coll., Hanover, N.H.
Christian S. Miller, and D. Dean Spatz.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $0.60. Office of Saline Water Research and Development Progress Report No 339, Mar 1968. 55 p, 17 fig, 8 tab, 36 ref, 4 append. OSW Contract No 14-01-0001-939.

Descriptors: *Desalination processes, *Reverse osmosis, *Water supply, Research and development, Brackish water, Membranes, Cellulose, Economics.
Identifiers: Cellulose acetate membranes, Polyester membranes, Drinking water.

Cellulose acetate desalination membrane technology and a simple, inexpensive desalination appliance which can supply water needs for a family of five are discussed. The proposed appliance will operate on the principle of reverse osmosis utilizing only the water pressure already present in the household water system. A testing program using a reverse osmosis cell has established the economic feasibility of using the method in larger systems. (Carstea-USGS)
W70-03667

THERMO-ECONOMICS OF SALINE WATER CONVERSION,
Dartmouth Coll., Hanover, N.H. Thayer School of Engineering.
Robert B. Evans, and Myron Tribus.
I and EC Process Design and Development, Vol 4, No 2, p 89-100, Apr 1965. 9 fig, 4 tab, 22 ref.

Descriptors: *Saline water, *Demineralization, *Thermodynamics, *Economics, Optimization, Energy, Desalination apparatus, Costs.
Identifiers: Optimum-energy technique.

The technological problems of saline water demineralization were set forth in concise form as they appeared in the light of an intensive study of the underlying principles of thermodynamics and economics. This was done by digesting the pertinent principles of thermodynamics and economics into a compact formalism which the writers call the 'Optimum-energy technique'. The essence of the optimum-energy technique was embodied in the use of the optimum-energy equation. The pertinent thermodynamics and economics were manifested in this equation in the form of two critical unit costs: energy costs and equipment costs. It was concluded that research programs in saline demineralization should be initiated for each type of desalination equipment with the specific goal of striving for lower conductance costs and lower available energy costs for each tentative energy source. Hope was expressed that optimum-energy technique, as a digest of the pertinent thermo-economics, would help to speed the advance of saline water conversion. (Thiuri-Cornell)
W70-03935

DESIGN AND COST OF ION-EXCHANGE SOFTENING FOR A 50-MGD SEA-WATER EVAPORATION PLANT,
California Univ., Berkeley. Sea Water Conversion Lab.
Gerhard Klein, Kamel M. Makar, Badawi W. Tleimat, and Theodore Vermeulen.
Sea Water Conversion Lab Rep No 68-2, Water Resources Center Desalination Rep No 25, Sept 1968. 59 p, 12 fig, 10 tab, 31 ref, 2 append.

Descriptors: *Design, *Costs, *Ion-exchange, *Water softening, Optimization, Sea water, Distillation, Pre-treatment (Water), Economics, Interest rate, Evaporators.
Identifiers: Calcium removal.

The optimization of a large desalting plant was discussed. Mathematical equations were developed and utilized to determine the economic feasibility of calcium removal by a large distillation plant. Sea water was pretreated to avoid scale formation during distillation. It was possible to express all costs that affected the optimization as functions of the saturation time elapsed in one cycle of operation. The design study resulted in an estimated cost for calcium removal of 3.6 or 3.8 cents per thousand gallons of distilled-water product from the evaporator, based on respective interest rates of 3.125 or 4.125 per cent per year on the depreciated plant investment. Since this pretreatment led to more economic distillation conditions, the attendant savings largely offset the cost of pretreatment. (Thiuri-Cornell)
W70-03945

TECHNOLOGY OF SEA WATER DESALINATION,
Weir (G. and J.) Ltd., Glasgow (Scotland).
Hugh C. Simpson, and R. S. Silver.
Selected Papers on Desalination and Ocean Technology, Dover Publications, New York, p 387-413, 1968. 3 fig, 2 tab, 7 ref.

Descriptors: *Desalination processes, *Fresh water, *Saline water, *Optimization, *Electrodialysis, *Reverse osmosis, Vapour compression distillation, Hydrate process, Mathematical studies.
Identifiers: Transfer area.

The processes for the recovery of fresh water from sea water were analyzed and the minimum costs of sea water desalination corresponding to optimum driving forces across the transfer surface were estimated by use of mathematical methods. Under optimum conditions the cost of sea-water desalination decreased slowly as the cost of transfer area and power and the transfer resistance were reduced. Electrodialysis, reverse osmosis, and vapor recompression were all likely to produce more expensive fresh water than multi-stage distillation for any reasonable costs of the transfer surface. Freezing and hydrate processes, on the other hand, could produce water at lower costs than could multi-stage distillation. However, the water costs for these latter two processes, have been under-estimated, since they can be evaluated with sufficient accuracy only by large scale experimental work. (Thiuri-Cornell)
W70-03946

3B. Water Yield Improvement

SNOW ALBEDO MODIFICATION - A REVIEW OF LITERATURE,
Army Terrestrial Sciences Center, Hanover, N.H.
For primary bibliographic entry see Field 02C.
W70-03652

SHAPING THE LAW OF WEATHER CONTROL,
For primary bibliographic entry see Field 06E.
W70-03719

LABORATORY TESTS OF SPRAYABLE MATERIALS FOR RUNOFF INDUCEMENT ON A LOESSIAL SOIL,
Hebrew Univ., Jerusalem (Israel). Faculty of Agriculture; and National Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculure Research.
For primary bibliographic entry see Field 02E.
W70-03804

RUNOFF INDUCEMENT IN ARID LANDS,
National and Univ. Inst of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research.
Daniel Hillel.
Final Technical Report to US Department of Agriculture, Rehovoth, 1967. 142 p, 34 tab, 46 fig, 83 ref. Project No A10-SWC-36. Grant No FG-Is-178.

Descriptors: *Arid lands, *Water harvesting, *Rainfall-runoff relationships, *Infiltration, *Soil sealants, Surface runoff, Slopes, Rainwater, Small watersheds, Surface sealing, Soil compaction, Wettability, Soil dispersants, Rainfall, Simulated rainfall, Rainfall intensity, Water yield improvement, Soil erosion, Economic feasibility.
Identifiers: *Israel.

If runoff from slopes can be artificially increased, it can be concentrated in crop planted areas. Thus, natural precipitation could be used more efficiently in agriculture. Results are presented of laboratory and field trials of several different materials and treatments tested to reduce infiltration and thereby increase runoff. All work was conducted in Israel. The various treatments were first screened in the laboratory with a specially designed rainfall simulator and the more promising were field tested in two areas. Results varied somewhat with soil type and rainfall intensity and duration. Under the right conditions it was found that runfff-to-rainfall ratios as high as 80 to 90% could be obtained. Types of treatments were mechanical smoothing and compaction and application of substances to bind, seal, crust, and waterproof the surface. The ultimate question is one of economic feasibility. Some preliminary cost figures are presented. (Crouse-Arizona)
W70-03809

A METHOD FOR STATISTICAL EVALUATION OF WEATHER MODIFICATION AT THE RIVER FLOW CONTROL LEVEL,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
Radmilo D. Markovic.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 80, p 641-647, 1967. 7 p, 3 fig, 2 ref. Bureau of Reclamation Contract No 14-06-D-5229.

Descriptors: *Weather modification, *Evaluation, *Streamflow, *Variability, *Statistical methods, Streamflow forecasting, Time series analysis.
Identifiers: Weather modification evaluation.

The natural variability of river flows is relatively high and the expected increase in water yield caused by weather modification experiments is relatively low. These two conflicting facts call for a very refined and sensitive method of solving the problem of statistical evaluation of weather modification attainments. The method developed and presented is one answer to the problem of weather modification evaluation. It was employed at the river flow control level by using the annual river flows as the main variable. The target-control concept was used in the development of the joint distribution function of target river flows conditioned by those in the control basin and the upper tailed test of significance with the intention of maximizing the discriminating power of this statistical test. The applicability of this method is demonstrated by an actual example. (Knapp-USGS)
W70-03848

HYDROLOGIC EFFECTS OF RAINFALL AUGMENTATION,
Stanford Univ., Calif. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-03931

3C. Use of Water of Impaired Quality

DISTRIBUTION OF CHLORIDES IN AN IRRIGATED CITRUS ORCHARD,
National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research.
B. Yaron, E. Mor, and A. Goell.
Israel Journal of Agricultural Research, Vol 18, No 4, p 201-208, Oct 1968. 1 tab, 4 fig, 6 ref.

Descriptors: *Arid lands, *Irrigation water, *Saline water, *Chlorides, *Citrus fruits, Leaching, Soil chemistry, Irrigation, Water quality, Soil-water-plant relationships.
Identifiers: *Israel.

If relatively saline water is used in irrigation, a build-up of chlorides in the soil may be expected. A value of 10 to 15 meq per liter of saturated soil paste has been suggested as the level of toxicity for citrus. This paper reports the chloride level and movement in the soil for one season of irrigation with water containing 2.9, 8.5, 11.3 and 15.5 meq per liter chlorides. The chlorides tended to accumulate between 30-90 cm. depth. The mean chloride content did not reach the 15 meq per liter level in one season for any of the treatments. However, the chlorides were only partially leached by the following winter rains, so a continuous build-up of chlorides from year to year might be expected with continuous use of saline irrigation water. (Crouse-Arizona)
W70-03799

3D. Conservation in Domestic and Municipal Use

PUBLIC PARKS, FORESTS AND RECREATION.

Tenn Code Ann secs 11-1401 thru 11-1417 (Supp 1969).

Descriptors: *Tennessee, *Rivers, *Conservation, *Water resources development, Legislation, Natural resources, Recreation, Eminent domain, Legal aspects, Administrative agencies, Federal government, Scenic easements, Local governments, River systems, Water pollution, Pollution abatement, Land use, Classification, Water conservation, Land management, Scenery.

River, free flowing, and scenic easements are defined. The three classes of scenic river areas are natural river areas, pastoral river and partially developed river areas. Natural river areas are those free-flowing rivers with shorelines and scenic vistas unchanged by man, with no extensive paralleling roads closer than one mile. Those free-flowing rivers, the lands adjacent to which are partially or predominately used for agriculture and other dispersed human activities which do not substantially interfere with public use and enjoyment of the rivers and their shores are pastoral river areas. Partially developed river areas are those rivers in areas affected by the works of man, but which still possess actual or potential scenic values. Regulations for the scenic rivers system which is administered by the Department of Conservation are provided. The Commissioner of Conservation establishes boundaries of the scenic river area and acquires land by donation, purchase, exchange, eminent domain or otherwise. Land uses permitted within a scenic river area are enumerated. The Commissioner of Conservation cooperates with appropriate water pollution control agencies and environmental management agencies for the purpose of eliminating or diminishing the pollution of waters within scenic river areas. (Powell-Florida)
W70-03746

WETTING AGENT TESTS.
Los Angeles City Fire Dept., Calif.

Los Angeles, Los Angeles City Fire Department, 1969. 16 p, 4 fig, 3 tab.

Descriptors: *Surfactants, *Wettability, *Surface tension, *Sprays, *Burning, Wetting.
Identifiers: *Wetting agents, *Firefighting, *Fire extinguishing, *Fire departments, Los Angeles City Fire Department.

A series of laboratory and field tests of wetting agents, conducted by the Los Angeles City Fire Department, is reported. The tests were made to evaluate the effectiveness, cost and practicality of using wetting agents as additives to water for facilitating fighting class A fires. The function of the wetting agents is to decrease the surface tension of the water droplets, and thereby increase water spread over combustible surfaces. It was found that the time and amount of water required to extinguish fires were considerably lessened when wetting agents were used. The increased penetration of water into burning materials, when wetting were used, reduced the potential of rekindles. In addition, firefighting efficiency was increased and the use of wetting agents proved to be economically feasible. No significant correlations were found to exist between field and laboratory tests. It was concluded that a method of metering the wetting agent directly into the firefighting apparatus, from a reservoir on the apparatus, should be developed. Recommendations were made for optimum wetting agent concentrations. Additional tests and development were recommended. (Poertner-Chicago)
W70-03812

LIGHT WATER AND PROTEIN FOAM.
Los Angeles City Fire Dept., Calif.

Los Angeles, Los Angeles City Fire Department, 1968. 31 p, 6 fig, 6 tab.

Descriptors: *Burning, *Wetting, *Sprays, *Surfactant, *Foaming, *Airports.
Identifiers: *Light water, *Protein foam, *Foaming agents, *Firefighting, *Fire extinguishing, *Extinguishing agents, Fire departments, Los Angeles City Fire Department, Airport fires.

The report is a detailed account of a series of tests made by the Los Angeles City Fire Department to make comparative evaluations of firefighting characteristics of Light Water and Protein-Type foams. Light water is described as a non-toxic fluorocarbon surfactant with appropriate foam stabilizers. The Protein foam liquid agent is non-corrosive and contains stabilizers, metallic salts, and other materials and preservatives. Five sets of controlled tests were conducted in pits at the Los Angeles International Airport. The same firefighters were used for all tests and all firefighting was conducted under identical controlled conditions. Data were recorded on wind; temperature; humidity; amount and kind of fuel; temperatures of agent, water and fuel; fire intensity; time of preburn; time to control; time to extinguish; and amount of extinguishing agent used. The tests varied in size and intensity of fire, type of equipment used, and application rate of foaming agent. The Light Water foam proved superior to the Protein foam in every test. In one test, involving the use of two 300 gpm turrets on a 2,730 sq. ft. fire, the results indicated Light Water foam to be 3.64 times as effective as Protein foam. (Poertner-Chicago)
W70-03813

WATER CONSERVANCY DISTRICTS.

Mo Ann Stat secs 257.010 thru 257.150 (1959).

Descriptors: *Missouri, *Water districts, *Water conservation, *Water resources development, Water management (Applied), Water allocation (Policy), Administrative agencies, Legal aspects, Legislation, Water control, Flood control, Watersheds (Basins), Maintenance, River basins, Watershed management, River basin development, Multiple-purpose projects.

The purpose of a river basin conservancy district is to enable residents of the area to participate in maintaining and improving local water resources. District projects may include alleviation of floods, conservation of water against drought, and development of the state's resources for sanitary, domestic, agricultural, recreational, and industrial purposes. 'River' and 'river basins' are defined. The circuit courts are authorized to organize river conservancy districts upon petition by affected landowners. A majority of those owning land within the proposed district must approve its creation in a referendum. (Powell-Florida)
W70-04029

WATER CONSERVANCY DISTRICTS.
Mo Ann Stat secs 257.160 thru 257.310 (1959).

Descriptors: *Missouri, *Water conservation, *Water resources development, *Water districts, Water management (Applied), Water allocation (Policy), Administrative agencies, Construction, Maintenance, Legal aspects, Legislation, Water control, Water conveyance, Watercourses (Legal), Water distribution (Applied), Water works, Permits, Condemnation, Riparian rights, Easements, Right-of-way, Watersheds (Basins), River basins.

The board of trustees of a water conservancy district is authorized to clean out, straighten, widen, alter, deepen or change the course or terminus of any ditch, drain, sewer, river, watercourse, pond, lake, creek, or natural stream within the district. The board is empowered to fill up any abandoned or altered watercourse and to concentrate, divert, or divide the flow of water within the district. The board is permitted to purchase, acquire, hold, sell, convey, encumber, lease control, or use necessary land and personal property. The board may construct, operate, maintain, preserve, or supervise engineering works and other works, improvements and facilities. The board of trustees may acquire any easement, riparian or other right within the district for right of way, holding basin or for any necessary purpose. Condemnation of land by the board is permitted. The board of trustees makes regulations for the adjustment, connection or coordination of watercourses, works, facilities or operations of the district. The criteria and procedures for the creation of a conservancy district for a primary drainage basin are enumerated. (Powell-Florida)
W70-04030

PUBLIC UTILITIES.
Mo Ann Stat secs 71.520 thru 71.550 (1952).

Descriptors: *Missouri, *Public utilities, *Cities, *Municipal water, Legislation, Domestic water, Contracts, Supply contracts, Legal aspects, Regulation, Local governments, Electric power, Electricity, Water distribution (Applied), Fuels, Natural gas, Sewage disposal, Sewage, Conduits, Water works, Water supply, Pumping.

Municipalities may enact ordinances authorizing and regulating public utility companies supplying light, heat, power, water, gas, or sewage disposal facilities. A municipality may authorize these utilities to make excavations, set up fixtures, install mains, and maintain and operate their plants, subject to the conditions of the ordinance, for a period of twenty years. Municipal authorities are authorized to contract with any Missouri corporation for the purpose of supplying the municipality with gas, electricity, or water. It is provided, however, that any such contract shall not have legal force until ratified by a two-thirds majority of those voting in a municipal election. Any municipality may contract, either separately or in conjunction with another municipality or private corporation, with any corporation engaged in pumping and delivering water at wholesale for domestic consumption. A municipality may own, either separately or in conjunction with another municipality or private corporation, water mains through which to procure an adequate supply of water for its inhabitants. Before any such contract shall be entered into, the contract must be approved by a majority of all the voters voting thereon at a special election held for that purpose. (Schram-Florida)
W70-04035

PUBLIC HEALTH (MUNICIPAL WATER SUPPLY).
Mo Ann Stat secs 71.700, 71.710 (1952).

Descriptors: *Missouri, *Cities, *Water supply, *Water sources, Legislation, Permits, Taxes, Wells, Water wells, Spring waters, Regulation, Inspection , Control, Testing, Water pollution, Water pollution control, Public health, Water quality, Local governments, Water permits, Well permits.
Identifiers: Licensing.

All cities in the state are authorized to regulate and license all springs, wells, or other sources of water supply from which water is sold or offered to the public or shipped for sale. The cities may levy and collect license taxes and provide for the inspection and analysis of such water supplies. All cities are authorized to enact ordinances for the protection of all water supply sources from contamination or danger of contamination. (Schram-Florida)
W70-04036

MISSOURI SOIL AND WATER CONSERVATION DISTRICTS LAW.

Mo Ann Stat secs 278.060 thru 278.155 (1963), as amended, (Supp 1970).

Descriptors: *Missouri, *Soil conservation, *Water conservation, *Water districts, Administrative agencies, Administration, Financing, Legal aspects, Legislation, Adjudication procedures, Taxes, Eminent domain, Assessments, Cities, State governments, Federal government, Contracts, Equipment, Coordination, Agriculture, Conservation, Water policy, Water resources.

The State Soil and Water Districts Commission is created to administer the soil and water conservation districts. The Commission shall: (1) formulate general soil and water policies for the districts; (2) receive funds for, and control disbursements to, the districts; (3) provide for referendums for the establishment or disestablishment of districts; and (4) enter into agreements with, and cooperate with federal agencies. This act provides procedures for: (1) the establishment of soil and water districts; (2) referendums; and (3) the establishment of boards of soil and water district supervisors. Soil and water districts shall: (1) be a corporate body; (2) promote measures for soil and water conservation; (3) cooperate with other agencies; (4) provide services, materials and equipment to land representatives; (5) accept contributions and expend monies; and (6) enter into contracts. Counties, cities and soil and water districts may cooperate for the purposes of this act. Soil and water supervisors may not levy taxes, issue bonds, make assessments, take contributions by exaction from soil and water districts, or exercise the right of eminent domain. (Marsee-Florida)
W70-04041

3E. Conservation in Industry

MINERAL RIGHTS VERSUS WATER RIGHTS,
For primary bibliographic entry see Field 06E.
W70-03735

3F. Conservation in Agriculture

EVAPORATIVE COOLING OF HEATED IRRIGATION WATER BY SPRINKLER APPLICATION,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.
For primary bibliographic entry see Field 05D.
W70-03718

DISTRIBUTION OF CHLORIDES IN AN IRRIGATED CITRUS ORCHARD,
National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research.
For primary bibliographic entry see Field 03C.
W70-03799

AN EVALUATION OF THREE COEFFICIENTS AS A MEASURE OF UNIFORMITY OF WATER APPLICATION BY SPRINKLERS,
Department of Agriculture, Swift Current (Saskatchewan). Research Station.
H. C. Korven.
Canadian Agricultural Engineering, Vol 10, No 2, p 83-84, Nov 1968. 1 tab, 7 ref.

Descriptors: *Sprinkler irrigation, *Application methods, *Uniformity coefficient, *Water measurement, Semiarid climates, Arid lands, Irrigation, Water management (Applied), Statistical methods, Measurement, Equations, Average, Spatial distribution, Regression analysis, Data processing, Rates of application.
Identifiers: *Canada, *Standard deviation, Saskatchewan.

When designing and operating a sprinkler irrigation system, it is important to know the uniformity of water application, since a level of uniformity is more efficient in using water for crop production. Three coefficients of uniformity that have had wide attention were calculated and compared for 775 uniformity tests on the semiarid plains of Saskatchewan. They were Cu, U, and A. The larger the coefficient, the better the uniformity. A high degree of correlation was found among the three coefficients. The author concludes that any of the three coefficients is an acceptable measure, but he suggests U is most practical since it is based on standard deviation--one of the most efficient estimators--and is easier to calculate. (Crouse-Arizona)
W70-03803

RUNOFF INDUCEMENT IN ARID LANDS,
National and Univ. Inst of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research.
For primary bibliographic entry see Field 03B.
W70-03809

WATER FOR WESTERN FEDERAL IRRIGATION PROJECTS,
Washington State Univ , Pullman.
E. Roy Tinney
Water Resources Management and Public Policy, Seattle, University of Washington Press, p 3-11, 1968. 9 p, 3 ref.

Descriptors: *Water supply, *Economic efficiency, *Irrigation, *Water resource development, Water losses, Water transfer, Demand, Cost, Government, Governments supports, Groundwater mining, Optimization, Value, Cost benefit analysis, Financing, Economic life, Income, Social aspects, Economic evaluation.
Identifiers: *Federal subsidies, *Social goals, Income distribution.

The chief agricultural problem of the West is the supply of irrigation water. Future federal irrigation developments should attempt to assure the nation of a fully adequate supply of the varieties of food and fiber, improve the general economy, and aid specific economicallydepressed areas. The federal government should adopt both an economic efficiency analysis and an income distribution analysis and abandon the hidden subsidies in benefit-cost analysis. Future federal projects should be ranked in ascending order of economic efficiency for each crop pattern so that Congress can make a more rational selection, taking note of the social goals involved. The article points out that interregional transfers should be analyzed on the basis of technological obsolescence of demand, crop production factors in the area of water abundance, the relative costs of water delivery at each end of the transfer, water losses incurred by the transfer and alternative means of increasing the water supplies in the recipient regions. (See W70-03995) (Murphy-Rutgers)
W70-03996

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

FLOOD PLAIN INFORMATION, ROSILLO CREEK, BEXAR COUNTY, TEXAS.
Corps of Engineers, Fort Worth, Tex.

Prepared for San Antonio River Authority. Corps of Engineers Flood Plain Report, Jan 1970. 33 p, 5 fig, 12 plate, 11 tab.

Descriptors: *Floods, *Flood damage, *Texas, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: *Bexar County (Tex), Standard project flood, Intermediate regional flood.

Flooding of Rosillo Creek, Bexar County, Texas is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-03647

DETERMINATION OF OPTIMAL FLOOD PROTECTION LEVELS WITH SMALL EXCEEDANCE PROBABILITIES,
Carnegie-Mellon Univ., Pittsburgh, Pa.
For primary bibliographic entry see Field 06A.
W70-03653

EFFECTS OF FLOOD PROTECTION ON LAND USE IN THE COON CREEK, WISCONSIN, WATERSHED,
Wisconsin Bureau of State Planning, Madison.
Donald F. Theiler.
Water Resources Research, Vol 5, No 6, p 1216-1222, Dec 1969. 7 p, 2 fig, 5 tab, 3 ref.

Descriptors: *Flood protection, *Small watersheds, *Land management, *Land use, *Wisconsin, Cost-benefit analysis, Planning, Soil conservation, Recreation.
Identifiers: Coon Creek watershed (Wis).

In justifying small watershed projects under Public Law 566, the U.S. Soil Conservation Service (SCS) frequently counts as a benefit the intensified use of agricultural land resulting from increased flood protection. Actual land use changes in Wisconsin were far less than predicted by the SCS. The reasons are less related to the watershed project than they are to changes in farming practices. The adequacy of project evaluation techniques is questioned, and suggestions are made for improvement. (Knapp-USGS)
W70-03654

USE OF THE CRITICAL PERIOD IN RESERVOIR ANALYSIS,
California Univ., Los Angeles.
W. A. Hall, A. J. Askew, and W. W-G. Yeh.
Water Resources Research, Vol 5, No 6, p 1205-1215, Dec 1969. 11 p, 4 fig, 3 tab, 4 ref. OWRR Project No B-061-CAL.

Descriptors: *Probability, *Streamflow forecasting, *Statistical models, Synthetic hydrology, Hydrograph analysis, Statistical methods, Meteorology, Reservoir management, Systems analysis.
Identifiers: *Critical period analysis, Synthetic hydrographs.

The 'critical period' in conjunction with reservoir design and operation is defined and an analysis is conducted of the usefulness of the concept in the evaluation of deficiencies of water for project planning purposes. Streamflow records from a number of rivers in the United States are analyzed, and certain defined characteristics of their various critical periods are derived. These characteristics are shown to be functions of both the active storage and the variation in annual streamflow. The dates of occurrence of the critical periods from historical records tend to be stable within certain geographic areas and over a range of active storages. Large numbers of equally likely hydrographs of the same length as the historical record were generated and compared with those found in the historical record. Some of the synthetic records produced critical periods in which the severity, measured by the decrease in the full record firm yield, was greater than the historical. However, the generated records as a whole had significantly less severity than the historical records of the same length. These observations suggest, but do not prove, that the more severe critical periods observed in historical records may be due to major perturbations of the cause-effect relationships not reflected by the hypothesis of static probability relationship. (Knapp-USGS)
W70-03655

FLOOD PLAIN INFORMATION, ARKANSAS RIVER, DODGE CITY, KANSAS.
Corps of Engineers, Albuquerque, N. Mex.

Corps of Engineers Flood Plain Report, Dec 1969. 39 p, 7 fig, 13 plate, 7 tab.

Descriptors: *Floods, *Flood damage, *Kansas, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: *Arkansas River, Dodge City (Kans), Standard project flood, Intermediate regional flood.

Flooding of the Arkansas River, Dodge City, Kansas is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-03668

CORPORATE POWERS (REGULATION OF WATER SUPPLY - FLOOD CONTROL).

Pa Stat Ann tit 53, sec 3743 (1957).

Descriptors: *Pennsylvania, *Cities, *Flood protection, *Regulation, Cisterns, Levees, Navigable waters, Flood walls, Floods, Dams, Streamflow, Obstruction to flow, Rivers, Legislation, Administration, Administrative agencies, State governments, Docks, Piers, Supervisory control (Power), Construction, Operation and maintenance, Channel improvement, Reservoir construction, Reservoirs, Legal aspects.
Identifiers: Ferries.

In addition to other powers granted by this act, the council of each city shall have the power to establish, make, fill and regulate public wells, cisterns, aqueducts, and reservoirs. Subject to the provisions of state law, the city councils may: (1) provide for the construction and maintenance of levees and ferries within the limits of the city; (2) erect wharves on navigable waters adjacent to the city, and regulate their use; (3) provide for protection against floods; (4) construct and maintain docks, retaining walls, dams or embankments; and (5) remove obstructions from, deepen and widen the channels of rivers and streams flowing through or adjacent to the city. (Barnett-Florida)
W70-03685

STOCHASTIC ASPECTS OF RESERVOIR STORAGE,
Manchester Univ. (England). Inst of Science and Technology.
For primary bibliographic entry see Field 02A.
W70-03706

APPLICATIONS OF MONTE CARLO METHOD TO RESERVOIR DESIGN,
Institute of Water Resources Research, Berlin (East Germany).
For primary bibliographic entry see Field 02A.
W70-03713

NUMERICAL SIMULATION OF WITHDRAWAL FROM A STRATIFIED RESERVOIR,
Oregon State Univ., Corvallis, Oreg.
For primary bibliographic entry see Field 08B.
W70-03716

WATERCOURSES (ALTERATION FOR BRIDGE CONSTRUCTION).

Ohio Rev Code Ann secs 6151.01 thru 6151.13 (Page, 1953), as amended, (Supp 1970).

Descriptors: *Ohio, *Bridges, *Streams, *Bridge construction, Legislation, Benefits, Public benefits, Project benefits, Washouts, Road construction, Rivers, Alteration of flow, Damages, Costs, Estimated costs, Diversion, Administrative agencies, Condemnation, Financing.

When necessary for the proper protection of location of a proposed bridge or road, the board of county commissioners may divert, alter, straighten or clean out any watercourse, acquire the necessary property, and settle all claims for damages. Expenses are payable out of the funds for the bridge or road. Before the work is begun, a petition setting forth the benefits to be derived from the project and other necessary details must be filed with the county auditor. An engineer is appointed to determine whether the proposal is beneficial and to estimate the costs. All costs for the proceedings are paid from the bridge funds of the county. (Douberley-Florida)
W70-03738

DRAINAGE AND LEVEE DISTRICTS.
Tenn Code Ann secs 70-735 thru 70-751 (1956), sec 70-752 (Supp 1969).

Descriptors: *Tennessee, *Drainage districts, *Local governments, *Assessments, Taxes, Drains, Levees, Cost repayment, Costs, Surveys, Damages, Engineers estimates, Project planning, Compensation, Coordination, Administration, Administrative agencies, Contracts, Watersheds (Basins).

Drainage districts may include land in more than one county. The clerk of the county court makes assessments for all lands in the district. The sufficiency and advisability of any petition for the establishment of a drainage district shall be determined by the county court after proper publication of notice. The court may require surveys and estimates of the costs of proposed improvements before approving a petition. Drainage districts may cooperate and contract with other districts, with any state agency, or with the federal government. Drainage districts may exercise all the powers exercised by watershed districts. (Dearing-Florida)
W70-03741

CORRECTION OF ERRORS IN ASSESSING DRAINAGE DISTRICT LANDS.
Tenn Code Ann secs 70-1001 thru 70-1007 (1956).

Descriptors: *Tennessee, *Drainage districts, *Assessments, *Remedies, Legislation, Payment, Evaluation, Taxes, Tax rate, Boundaries (Property), Boundary disputes, Legal aspects, Administration, Administrative agencies, Administrative decisions, Appraisals, Damages.

Mistakes in assessments against landowners made by drainage district authorities may be corrected upon petition by the aggrieved landowners to the county court. Either the landowner or the district directors may appeal the court's assessment decision. No petition for correction of a mistake in boundaries will be heard after the decree fixing the number of acres has been confirmed and entered on the assessment roll. When an incorrect assessment has been made, the decree fixing such assessment shall not be final and any aggrieved party may petition the county court to correct the mistake. Upon a finding that a mistkae was made, all reports, decrees, blue prints, maps, and plats shall be amended accordingly. An appeal from such a decision may be made to the circuit court, where the cause will be heard de novo. (Schram-Florida)
W70-03742

DRAINAGE DISTRICTS (CONSTRUCTION OF IMPROVEMENTS).
Tenn Code Ann secs 70-1201 thru 70-1232 (1956).

Descriptors: *Tennessee, *Administrative agencies, *Drainage districts, *Drainage engineering, Drainage systems, Drainage practices, Controlled drainage, Drainage, Laterals, Outlets, Legislation, State governments, Administration, Channels, Legal aspects, Watercourses (Legal), Relative rights, Ditches, Drains, Assessments, Construction, Conveyance structures.

The county court is empowered to appoint members to the board of directors of drainage districts. Each board may enter into contracts for improve-

ments in its district. A bonded engineer is to be employed to supervise construction of improvements and to file monthly work estimates upon which compensation will be based. Each board is directed to employ a 'drainage overseer' to efficiently maintain improvements constructed within its district. The owner of any land assessed for construction costs of an improvement has the privilege of using the improvement, subject to the control and approval of the board of directors. The board for each district is required to settle disputes between landowners regarding use of lateral ditches or drains. Each board may assess damages for violations of this act. Assessments for improvements are to be collected as taxes but must be kept in a separate fund. Criminal penalties are imposed for injury to any drainage improvement. (Barnett-Florida)
W70-03743

WATERS, DRAINS, AND LEVEES (DISTRICTS IN MORE THAN ONE COUNTY).
Tenn Code Ann secs 70-1501 thru 70-1514 (1956).

Descriptors: *Tennessee, *Drainage districts, *Administrative agencies, *Drainage practices, Drainage programs, Drainage systems, Local governments, State governments, Legislation, Regulation, Drainage engineering, Engineers estimates, Cost repayment, Administrative costs, Cost allocation, Construction, Assessments, Legal aspects, Project planning, Coordination, Administration, Permits.

Where a proposed drainage improvement is to be located in more than one county, application must be made to the county courts of each county. Upon application, a court appointed engineer will survey the entire area and report to each county in the district. The court is authorized to appoint viewers to assess damages to each county. County courts are directed to appoint commissioners to assess and apportion the costs of the proposed improvement. A board of directors for a district encompassing more than one county shall consist of one member from each county. County courts retain the power to remove any commissioner, viewer, or director. An alternate method of establishing improvement or drainage districts lying in more than one county is provided. (Barnett-Florida)
W70-03744

SWAMP AND OVERFLOWED LAND.
Mo Ann Stat secs 241.010 thru 241.130 (1952).

Descriptors: *Missouri, *Land reclamation, *Federal reclamation law, *Swamps, Patents, Legislation, Legal aspects, State governments, Standing waters, Surface waters, Reclamation states, Proprietary power, Public lands, Federal government, Conservation, Land development, Land management, Agricultural engineering.

Swamp and overflow lands were granted to the state of Missouri by an act of Congress entitled 'An act to enable the state of Arkansas and other states to reclaim the swamp lands within their limits.' In order to provide for the reclamation of all overflowed and swamp lands, all Missouri lands are donated to the counties in which they may be situated. The duties of the Secretary of State, which include acting as swamp land agent, are enumerated. Title to all swamp or overflowed lands is conveyed by patent issued by the Secretary of State. The preparation, issuance and recordation of patents are regulated. All patents are prima facie evidence of title. (Powell-Florida)
W70-03756

SWAMP AND OVERFLOWED LANDS (PATENTS AND CONTRACTS).
Mo Ann Stat secs 241.140 thru 241.240 (1952), as amended, (Supp 1970).

Descriptors: *Missouri, *Swamps, *Patents, *Contracts, Control, Marshes, Surface waters, Land reclamation, Wetlands, Legal aspects, Legislation, Contract administration, Regulation.

Control over patented swamp and overflowed lands is vested in the several county courts. Procedures involving the sale of swamp or overflowed lands by the county are provided. The conditions necessary for the cancellation of swamp or overflowed land sale contracts are enumerated. The clerk of the county court issues a patent for the swamp or overflowed land upon full payment by the purchaser. (Powell-Florida)
W70-03757

SWAMP AND OVERFLOWED LANDS (RECLAMATION AND ASSESSMENT OF DAMAGES).
Mo Ann Stat secs 241.250 thru 241.280 (1952).

Descriptors: *Missouri, *Land reclamation, *Damages, *Overflow, Land, Legislation, Local governments, Swamps, Reclamation, Ditches, Levees, Drainage, Drainage systems, Administrative agencies, Payment, Surface drainage, Drainage programs, Judicial decisions, Legal aspects, Compensation, Assessments.

The county courts may appoint commissioners to superintend the surveying, draining, and reclamation of overflowed and swamp lands within the respective counties and may borrow money and issue bonds of the county for these projects. If the owners of any land through which any ditch or levee is proposed to be constructed or cut object to such construction, the commissioners shall obtain a summons for a jury to inquire into the damages the owners may sustain. A civil trial shall be conducted in a magistrate's court, and the jury's assessment of damages shall be specified in writing. If the county court determines that it is best to pay the damages, the money shall be paid to the landowner from the county treasury. If the objecting landowner refuses to accept the payment, the ditch or levee may be constructed, and the landowner shall be forever barred from maintaining any further action. Malicious destruction of any ditch or levee is a misdemeanor punishable by up to one thousand dollars fine and/or six months imprisonment. (Schram-Florida)
W70-03758

ANNEXATION OF OLD DRAINAGE DISTRICTS BY NEW DRAINAGE DISTRICTS.
Mo Ann Stat secs 242.692 thru 242.699 (Supp 1970).

Descriptors: *Missouri, *Drainage districts, *Outlets, *Boundaries (Property), Legislation, Legal aspects, Administrative agencies, Land tenure, Judicial decisions, Assessments, Taxes, Cost-benefit theory, Administration, Drainage systems.
Identifiers: *Annexation, Reorganization.

The drainage districts whcih desires to be annexed will be known as the minor district. The district to which the minor district desires to be annexed will be known as the major district. The board of supervisors of any minor district may petition any major district for annexation thereto providing the two districts have a common outlet or the major district has an outlet for the use of the minor district. The necessary contents of the petition are specified. The petition will be filed in the circuit court which incorporated the major district. The board of supervisors of the major district may either accept or reject the petition. If the petition is accepted, the clerk of the circuit court will publish notice thereof. Owners of land in the minor district may object to the petition and such objections will be heard in circuit court. The court will determine whether or not to issue a decree annexing the minor district to the major district. (Keith-Florida)
W70-03760

DRAINAGE DISTRICTS FOR MINING PURPOSES.

Mo Ann Stat secs 242.700 thru 242.750 (1952).

Descriptors: *Missouri, *Drainage districts, *Land reclamation, *Mining, Administrative agencies, Mine drainage, Land tenure, Leases, Easements, Pumps, Pumping plants, Pumping, Watercourses (Legal), Planning, Excavation, Taxes, Financing, Surveys, Legislation, Right-of-way, Legal aspects, Mining engineering, Mineralogy.
Identifiers: Underground watercourses.

When the state geologist certifies that certain lands are likely to contain valuable mineral deposits, owners of these lands may form a mining drainage district to drain their lands for mining purposes. Such districts shall have the power to purchase, construct, own or lease pumping plants in order to promote the draining and reclamation of mineralized lands. The chief engineer of any mining district shall make a survey of mineralized lands and submit a reclamation plan to the board of supervisors of the district outlining the methods of reclaiming the lands for mining purposes. The districts' projects shall be financed through the issuance of bonds and through the levy of a pumping tax on the gross value of mineral concentrates derived from the land. (Duss-Florida)
W70-03761

CONSOLIDATION OF DRAINAGE DISTRICTS.

Mo Ann Stat secs 243.450 thru 243.540 (1952), as amended, (Supp 1970).

Descriptors: *Missouri, *Drainage districts, *Administrative agencies, *Judicial decisions, Land tenure, Financing, Benefits, Assessments, Costs, Taxes, Construction, Legislation, Legal aspects.
Identifiers: *Penalties (Criminal), Improvements.

Upon petition by one-fourth of the landowners in two or more drainage districts, such districts may reorganize into one district. Petitions shall be to the circuit court of the county containing the greatest acreage of land in the proposed district. Petitions shall contain descriptions of the land and districts involved. The clerk of the circuit court shall cause notice of the petition to be published. Any owner of real or other property in the proposed district, not signing the petition, may file objections to the petition which shall be reviewed by the court. Penalties are provided for officials who fail to carry out their duties to the district. The validity of bonds issued by districts shall not be questioned in any court, except for the power to issue such bonds. Suits on bonds for costs and performance of work shall be brought in the name of Missouri. Appeals from county court decisions regarding drainage districts shall be to the circuit court. This chapter is remedial in character and drainage districts already in existence retain all powers heretofore granted by the state. Penalties for violations of this chapter are provided. (Duss-Florida)
W70-03762

CITY OF PORT RICHEY V ADAMEK (CONSTRUCTION OF A DOCK EXTENDING INTO A NAVIGABLE RIVER).

228 So 2d 428-431 (2d DCA Fla 1969).

Descriptors: *Boundaries (Property), *Docks, *Local governments, *Navigable rivers, Legislation, Judicial decisions, Ownership of beds, Beds under water, High water mark, Real property, Channels, Shores, Permits, Legal aspects, Boundary disputes, Water rights, Shallow water, Building codes, Structures, Construction, Land tenure, Cities, Navigation, Regulation.

Plaintiff, a property owner, requested the court to determine the boundary of his waterfront lot and to require defendant city to permit construction of a dock extending from his property into a navigable river. An approved plat of the sub-division revealed that plaintiff's property line extended forty-one feet into the river. A municipal ordinance permitted boat docks and piers to extend no more than 20 feet into a waterway from the property line. Defendant claimed that the proposed dock would extend

more than twenty feet into the river and denied plaintiff's application for a building permit for that reason. The circuit court declared that plaintiff's property line was that shown on the plat and not the shoreline. Because the water immediately adjacent to the shoreline was shallow and non-navigable, the court held that the dock would not impede the natural flow of water, encroach upon the channel, or unduly restrict the use of the waterway by adjoining property owners. On appeal, the city claimed that Florida law permits private ownership of lands bordering on navigable waters only to the high water mark. The district court rejected this contention and affirmed the circuit court's decision, holding that construction of the proposed dock would not violate the city ordinance. (Schram-Florida)
W70-03763

KOMMANVITTSELSKAPET HARWI V UNITED STATES (ACTION AGAINST FEDERAL GOVERNMENT FOR ALLEGED FAILURE TO MAINTAIN CHANNEL).
305 F Supp 882-895 (ED Pa 1969).

Descriptors: *Navigation, *Navigable rivers, *Admiralty, *Channels, Ships, Shoals, Warning systems, Depth, Buoys, Publications, Federal government, Administrative agencies, Legal aspects, Federal jurisdiction, Interstate rivers, Delaware River, Surveys, Channel improvement, Dredging, Damages, Charts, Judicial decisions, Remedies.

Foreign shipowners brought this action for damages against the United States under the Suits in Admiralty Act. Plaintiffs charged that negligence on the part of the United States government led to the grounding of their vessel on a shoal in the Delaware River. Specifically, they contended that the United States had assumed the duty of maintaining and surveying the channel in which the ship was damaged and that the United States negligently failed to notify users of the Delaware River that the existing channel could not safely be used for navigation. Plaintiffs alleged further that the United States negligently failed to publish information concerning the depth of the channel and failed to mark and alternate channel with temporary markers during channel construction. The court rejected these contentions, holding that even if the federal government has assumed the responsibility for regularly surveying and maintaining the channel, there was no evidence that the government was aware of the existence of the particular shoal in question. The court stated that even though the Corps of Engineers periodically publishes depth charts for certain channels, this does not justify navigators in relying upon the government to dredge and survey all channels in navigable interstate waterways. (Schram-Florida)
W70-03766

PARTITION WHEN LAND BOUNDED BY WATER.
Wis Stat Ann sec 90.09 (1957).

Descriptors: *Wisconsin, *Boundaries (Property), *Boundary disputes, *Structures, Legislation, Negotiations, Rivers, Ponds, Streams, Legal aspects, Relative rights, Cost allocation, Cost sharing, Riparian land.
Identifiers: *Fences.

When the boundary line between enclosed lands of different persons is a river, brook, pond, or creek which does not form a sufficient fence, and it is impracticable because of unreasonable expense to build the fence on the true boundary line, and either owner refuses to join in making a partition fence on either side, application may be made to two fence viewers who will determine if the river, brook, pond, or creek is an insufficient boundary. If so determined, the viewers will put in writing how, when, and where the fence is to be erected along with an assessment of cost to each of the disputing owners. This paper is filed with the town clerk and recorded. If either party refuses or neglects to build his share of the fence, the other party may complete the fence and recover the expense thereof from the refusing party. If the viewers determine it impracticable to build any fence, written notice of such determination shall be given to the disputing parties. (Barnett-Florida)
W70-03786

WISCONSIN FLOOD CONTROL AGENCIES.

Wis Stat Ann secs 87.12-87.18 (1957), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Administrative agencies, *Flood control, *Coordination, Legal aspects, Financing, Assessments, State governments, Reservoirs, Flood protection, Flood plains, Land tenure, Rivers, Maintenance, Operation and maintenance, Surveys, Leases, Construction, Construction costs, Repairing, Administration, Cities, Legislation, Cost allocation, Operating costs.

A Flood Control Board is hereby established to coordinate and supervise the construction, maintenance, and operation of flood control improvements authorized by the Department of Resource Development. The Board is authorized to: (1) contract for the construction of improvements; (2) enter upon lands to conduct surveys and examinations; (3) borrow money for reservoir construction; (4) sell or lease reservoirs; and (5) petition the Department for authorization to improve existing works. Penalties are provided for trespass upon, obstruction of, or interference with improvements. Leases, sales, and leases with options to purchase storage reservoirs may be secured only in accordance with the procedures herein established. Costs of maintenance and operation of flood control improvements are assessed against municipalities and owners of unincorporated land within the district. (Marsee-Florida)
W70-03789

WISCONSIN FLOOD CONTROL.
Wis Stat Ann secs 87.01-87.11 (1957), as amended, (Supp 1969).

Descriptors: *Wisconsin, *Flood control, *Administrative agencies, *Administration, Financing, Costs, Assessments, Dams, Dikes, Diversion, Flood protection, Levees, Reservoirs, Sewers, Ditches, Lakes, Rivers, Navigation, Floodways, Pumping plants, Siphons, State governments, Federal government, Legal aspects, Parks, Legislation, Channel improvement, Alteration of flow, Obstruction to flow.

For purposes of flood control, the Department of Resource Development may straighten, widen, alter, or remove obstructions from any river, watercourse, lake, pond, creek, natural stream, ditch, drain, or sewer, and may concentrate, divide or divert the flow of water therein. However, no such work may substantially impair navigability. The Department may also construct, maintain, or remove ditches, canals, levees, dikes, dams, sluices, revetments, reservoirs, holding basins, floodways, pumping stations, sewers, siphons, and other works necessary for the purposes of this act. Procedures governing flood-work petitions and hearings are herein set forth, as are provisions relating to financing, costs, assessment of benefits, collection of assessments and exemption of public parks from assessments. Public corporations or flood control boards may enter into agreements with federal agencies to cooperate in the construction, operation or maintenance of any federally authorized project contemplated herein. Drainage area is defined. (Marsee-Florida)
W70-03802

DRAINAGE MASTER PLAN FOR THE CITY OF FORT WORTH PUBLIC WORKS DEPARTMENT, STORM DRAINAGE CRITERIA AND DESIGN MANUAL.
Knowlton-Ratliff-English, Fort Worth, Tex.

For primary bibliographic entry see Field 08A.
W70-03814

ON THE EXTREME VALUE DISTRIBUTION FOR DESCRIBING ANNUAL FLOOD SERIES,
New South Wales Univ., Kensington (Australia).
For primary bibliographic entry see Field 02E.
W70-03854

A PEAK DISCHARGE RELATION FOR INTERMEDIATE DRAINAGE BASINS,
Queen's Univ., Kingston (Ontario).
For primary bibliographic entry see Field 02E.
W70-03855

ESTIMATION OF STATISTICAL PARAMETERS FOR ANNUAL RIVER FLOWS,
Universidad Nacional del Zulia, Maracaibo (Venezuela).
For primary bibliographic entry see Field 02E.
W70-03858

COMPARISON OF SMART AND SCHEIDEGGER STREAM LENGTH MODELS,
IBM Watson Research Center, Yorktown Heights, N.Y.
For primary bibliographic entry see Field 02E.
W70-03862

FLOOD PLAIN INFORMATION, LOOKINGGLASS RIVER, CLINTON COUNTY, MICHIGAN.
Corps of Engineers, Detroit, Mich.

Prepared for Water Resources Comm, Mich Dept of Natural Resources and Tri-County Regional Planning Comm. Corps of Engineers Flood Plain Report, Dec 1969. 43 p, 8 fig, 34 plate, 12 tab.

Descriptors: *Floods, *Flood damage, *Michigan, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: *Clinton County (Mich), Standard project flood, Intermediate regional flood.

Flooding of the Lookingglass River, Clinton County, Michigan is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-03868

EVALUATION OF EXCEEDANCE PROBABILITY OF FLOOD FOR FLOOD-PROTECTION WORKS IN RIVER,
Kyoto Univ. (Japan). Disasters Prevention Research Inst.
Yasuo Ishihara, and Masashi Nagao.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 69, p 556-564, 1967. 9 p, 7 fig, 2 ref.

Descriptors: *Water management (Applied), *Streamflow forecasting, *Reservoir design, *Reservoir operation, *Statistical methods, Probability, Regulation, Flood protection, Flood forecasting, Statistical models, Peak discharge, Rainfall-runoff relationships.
Identifiers: Drainage basin management.

There are many factors to be taken account of in designing various water works such as reservoirs and embankments, in which the hydrological quantities become the dominant factor. In estimating the occurrence probabilities of the quantities, multi-dimensional consideration is preferable to

the one-dimensional. The theoretical method of estimation of the exceedance probability by using the two-dimensional probability theory of normal distribution is discussed. The theoretical deduction of the joint exceedance probability is given and several methods available for estimation of the probability for the case where there are a flood-control reservoir and an embankment reach, are presented. As the results of this approach, it is shown that the exceedance probability taking account of the correlation among the related factors becomes smaller than that of the independent events. (Knapp-USGS)
W70-03886

PURPOSE AND PERFORMANCE OF PEAK PREDICTIONS,
Pennsylvania State Univ., University Park, Pa. Dept. of Civil Engineering; and Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
Brian M. Reich.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 70, p 565-572, 1967. 5 fig, 2 tab, 8 ref. Bureau of Land Management Contract No 14-11-0008-0590-62.

Descriptors: *Flood forecasting, *Small watersheds, *Statistical methods, *Peak discharge, Rational formula, Hydrologic budget, Rainfall-runoff relationships, Runoff forecasting, Streamflow forecasting, Evaluation.
Identifiers: Flood prediction formulas.

Five current methods for estimating flood peaks expected from ungaged rural drainages of small areas are discussed. Predictions are made with the 5 methods on 45 streams at 19 locations widely spaced across the United States. The methods were tested in arid as well as non-arid regions, beyond the geologic zones for which they were developed, and according to other criteria in a search for adaptability and generality. The scatter resulting from these considerations of 134 observed floods is discussed in the light of requirements and restrictions imposed by the authors of design techniques. Diagrams and statistics illustrate the uncertainties involved and show which methods under- or over-predict for this sample from nature. (Knapp-USGS)
W70-03887

DISCRIMINATING THE CHANGE IN MEANS OF HYDROLOGIC VARIABLES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
Radmillo D. Markovic.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 72, p 581-588, 1967. 8 p, 3 fig, 4 ref. Bureau of Reclamation Contract No 14-06-D-5299.

Descriptors: *Streamflow forecasting, *Statistical methods, *Reviews, Regression analysis, Probability, Stochastic processes, Stage-discharge relations.
Identifiers: Streamflow probability.

Significant natural or manmade changes of climatic, physiographic, and other conditions influencing hydrologic phenomena may cause the sample means of hydrologic variables describing these phenomena to change. The statistical methods for discriminating these changes in the means of hydrologic variables are discussed. The methods were derived by employing either the target or target-control concept and by applying the univariate, bivariate, or conditional distribution function of target and control hydrologic variables. Each of the methods presented here may be applied under specified particular conditions. (Knapp-USGS)
W70-03888

ERRORS IN DISCHARGE ESTIMATES ON MOUNTAIN STREAMS,
Ontario Agricultural Coll., Guelph. School of Agricultural Engineering.
For primary bibliographic entry see Field 02A.
W70-03889

DELTA AND PINE LAND CO OF MISSISSIPPI V BOARD OF SUPERVISORS OF BOLIVAR COUNTY (LEASING OF LEVEE DISTRICTS LAND).

228 So 2d 893-896 (Miss 1969).

Descriptors: *Mississippi, *Levees, *Leases, *Administrative decisions, Bids, Floods, Alluvium, Flood control, Flood protection, Legislation, Administrative agencies, Real property, State governments, Land management, Mississippi River, Jurisdiction, Legal aspects, Contracts, Land tenure, Judicial decisions.
Identifiers: *Alluvium lands, *Levee districts.

Pursuant to a special statute regulating the leasing of lands within levee districts, the Board of Supervisors leased two sections of land to the person who had submitted the highest sealed bid. The holder of the previous leases appealed the order of the Board, contending that because they submitted bids in excess of the highest sealed bids after learning the amount thereof, they were entitled to the leases. The Supreme Court of Mississippi affirmed the Board's order and held that the regulatory statute was not unconstitutional for failing to give preference to previous leaseholders. Appellant pointed out that another statute regulating the leasing of government lands contained provisions for giving preference to previous leaseholders, and contended that the statute should be applied to this leasing arrangement. Rejecting this contention, the court held that the state had legitimately classified lands composed of alluvium soil into levee districts, and the special statute regulating the leasing of 16th section lands located within these districts should control. Alluvium lands are defined as those built by deposits of sediment from streams and floods. (Schram-Florida)
W70-03907

COSTS AND MAINTENANCE OF DRAINAGE DISTRICTS.

Mo Ann Stat secs 243.320 thru 243.440 (1952), as amended, (Supp 1970).

Descriptors: *Missouri, *Administrative agencies, *Drainage districts, *Financing, Legislation, Ditches, Drains, Levees, Maintenance, Maintenance costs, Costs, Cost allocation, Benefits, Taxes, Construction, Boats, Dredging, Assessments, Excavation, Land tenure, Real property, Regulation, Railroads, Roads.
Identifiers: Penalties (Civil), Dredge boats, Liens.

The cost of drainage ditches shall be apportioned to the entities owning the public roads of railroads which are benefitted. The county court has the duty to levy a maintenance tax to maintain the work of the drainage district. A portion of this tax may be set aside for the purchase of dredge boats, tools, or other machinery necessary for maintenance of the drainage district. Various provisions outline the payment of drainage taxes for district improvements and the method of administering the maintenance tax. All drainage taxes including maintenance taxes, penalties, and costs of collection constitute liens upon the property taxed until the taxes are paid. The county court may prorate surplus funds back to the taxpayers or use them for maintenance in lieu of maintenance taxes. The county court may issue bonds to finance the costs of drainage improvements. Regulations regarding the issuance of bonds are provided. Such bonds may be pledged to any corporation, commission or agency created or authorized by Congress or the state of Missouri. (Duss-Florida)
W70-03912

DRAINS, DRAINAGE PROCEEDINGS, AND DRAINAGE DISTRICTS.

Wis Stat Ann secs 88.01, 88.03, 88.08, 88.09, 88.12-88.17 (Supp 1969).

Descriptors: *Wisconsin, *Drainage, *Drainage districts, *Drains, Regions, Governments, State governments, Administrative agencies, Legal aspects, Costs, Cost allocation, Jurisdiction, Drainage engineering, Drainage programs, Administration, Tiles, Pipes, Pumping, Ditches, Water control, Legislation, Drainage practices, Water conveyance, Supervisory control (Power), Diversion, Surface drainage, Surface runoff.

Drainage proceedings are quitable in nature. The county court maintains supervisory control over the actions of the drainage board, and may require the board to submit reports of its proceedings. Provision is made for the taxing of costs in drainage proceedings. Decisions of the drainage board may be appealed to the supreme court of the state. When a proposed drainage area covers portions of more than one county, the county containing the greatest acreage proposed for drainage has jurisdiction over the organization and operation of the district. 'Drain' means any device used for the drainage of water from land or the protection of land from surface water, including open ditches, tiles, pipelines, pumps, and levees. (Marsee-Florida)
W70-03920

RESERVOIR SYSTEM DESIGN OPTIMIZATION,
Esso Research and Engineering Co., Florham Park, N.J. Environmental Control.
Richard J. Butsch.
Proceedings of ASCE, J Hydraul Div, Vol 96, No HY 1, p 125-130, Jan 1970. 1 tab, 8 ref, 2 append.

Descriptors: *Optimization, *Reservoir design, *Linear programming, *Dynamic programming, *Decision making, Locating, River basins, Size, Benefits.
Identifiers: Operating Criteria.

The optimization of a reservoir system by the use of selective mathematical techniques was discussed. A method was described by which optimum sizes, number and locations of reservoirs in a river basin could be determined. A variety of optimization techniques were used to evaluate promising designs on the basis of greatest economic benefits. Three levels of decision were required: (a) choosing the number and locations of reservoirs, (b) choosing size and operating criteria, and (c) the optimizing operation. Each level was optimized in turn, the optimization of lower levels being nested within higher ones. Techniques were chosen on the basis of their efficiency in each part of the design. Linear programming was used to optimize operations, dynamic programming used to optimize total benefits and optimum seeking methods used for optimizing decision variables. (Thiuri-Cornell)
W70-03941

WATER RESOURCE DEVELOPMENT IN CALIFORNIA: THE COMPARATIVE EFFICIENCY OF LOCAL, STATE AND FEDERAL AGENCIES,
California Univ., Berkeley.
Joe S. Bain.
Water Resources Management and Public Policy, Seattle, University of Washington Press, p 12-29, 1968. 18 p.

Descriptors: *Economic efficiency, *Water resource development, Local government, State government, Federal government, Surface waters, Water allocation, Hydrology, Water usage, Economic evaluation, Water supply, Water demand, Water transfer, Public utilities, Irrigation, Flood control, Dams, Reservoirs, River-basin development, Prices, Average cost, Water districts, Cost-benefit analysis, Interest rate, Discount rate.
Identifiers: *Central Valley, Local agencies, State agencies, Federal agencies.

ndings are reported concerning the development f surface waters of the Central Valley of Califor-a. Chief concern are the quality of the per-rmance of local, state and federal water agencies ith respect to the level of water resource develop-ent and the allocation of water among types, sites nd times of use. Discussion is concerned with the conomic efficiency in these respects of local water gencies as one group and the federal agencies gether with the California Department of Water esources as another. It also brings out some ap-arent historical and structural reasons for dif-rentials in economic efficiency between the two roups of agencies. The best case for comprehen-ve river-basin development by a central agency is here appreciable settlement and prior water evelopment is absent. (See W70-03995). Murphy-Rutgers)
70-03997

RAINAGE DISTRICTS ORGANIZED IN OUNTY COURT.

lo Ann Stat secs 242.240 thru 243.310 (1952), as nended, (Supp 1970).

escriptors: *Missouri, *Drainage districts, *Sur-ce drainage, *Management, Legislation, Legal spects, Drains, ditches, Levees, Maintenance, epairing, Construction, Watercourses (Legal), aterals, Outlets, Taxes, Costs, Cities, Leases, enefits, Damages, Cost-benefit theory, Financing, dministration, Assessments, Jurisdiction, Super-sory control (Power), Operation and main-nance.
lentifiers: Bonds.

he county courts are charged with the manage-ent and control of all drainage districts, existing r hereafter organized. The courts have the duty nd power to maintain, preserve, restore, repair, rengthen, and replace the drains, ditches, and vees of the districts. Any person may construct teral ditches or drains for the purpose of draining ater into any district ditch, drain or watercourse, rovided such lateral ditch or drain enters the dis-ict ditch, drain, or water-course through boxes or ling placed at the intersection of the ditches. rainage districts may contract with any city to rnish an outlet for the drainage of such city. The ourt can require one district to lease its equipment another district. After the incorporation of a dis-ict, the court will levy a special tax of no more an fifty cents per acre on each acre of land within e district to pay for district organization and any ther necessary expenses to be incurred before the ourt may levy taxes or issue bonds to provide nds to pay for district improvements. Ordinary xes will be levied on the land in porportion to the enefits received. (Keith-Florida)
70-04020

EVEE DISTRICTS.

lo Ann Stat secs 245.455 thru 245.545 (1959).

escriptors: *Missouri, *Levees, *Flood protec-on, *Project planning, Legal aspects, Legislation, ngineering structures, Flood control, Assess-ents, Engineers estimates, Administration, Ad-inistrative agencies, Construction, Appropria-on, Swamps, Conservation, Drainage practices, iversion, Diversion structures, Barriers.

andowners within the levee district determine hich new projects or repairs will be undertaken by e district. They are to base their decision in part on the reports and estimates of the engineer and on assessments by district assessors for the robable costs of the work. The board of directors r a levee district may call a meeting of the lan-owners in the district whenever the board ascer-ins that the levees constructed by the district are sufficient to afford complete protection from verflows. The board may recommend the rengthening and enlarging of the levees at this eeting. The procedures for the construction and nprovement of levees are prescribed. The county court may appropriate swamp lands belonging to the county for the purpose of constructing a levee. (Powell-Florida)
W70-04021

THIRD CLASS CITIES.
Mo Ann Stas secs 77.140, 77.150 (1952).

Descriptors: *Missouri, *Cities, *Channel im-provement, *Mineral water, Legislation, Con-demnation, Reservoirs, Flood protection, Lakes, Dams, Dam construction, Parks, Local govern-ments, Pipelines, Construction, Municipal water, Springs, Cisterns, Engineering structures, Hydrau-lic structures, Well regulations, Wells, Water wells, Taxes, Costs, Profit, Channels, Supervisory control (Power).

The councils of third class cities are authorized to establish, alter and change the channel of water-courses. They may prevent obstructions of chan-nels and may establish and regulate public wells, cisterns and reservoirs of water. The city councils may purchase land and provide for the establish-ment of public parks. The mayor and council of third class cities are authorized to acquire by gift, purchase, or condemnation all necessary or desira-ble lands for the construction of dams, lake and flood protection systems, bathhouses, and mineral water vending houses. They may also acquire lands for the laying of pipelines for the distribution of mineral waters. They may improve and operate mineral springs and wells and construct all necessa-ry buildings and works for the purpose of maintain-ing these properties as revenue producing public projects. These properties may be leased or con-veyed for this purpose. These projects shall not be acquired, constructed or maintained by either general or special taxes. (Schram-Florida)
W70-04037

CITIES OF THIRD CLASS (POWER TO REGU-LATE LEVEES).
Mo Ann Stat secs 77.530, 77.540 (1952).

Descriptors: *Missouri, *Local governments, *Levees, *Regulation, Diseases, Legislation, Human diseases, Public health, Environmental sanitation, Epidemics, Municipal wastes, Con-demnation, Sewers, Cities, Outlets, Conveyance structures, Disposal, Water works, Hospitals, Rail-roads, Docks, Supervisory control (Power), Legal aspects.
Identifiers: *Quarantines.

The councils of third class cities are authorized to enact ordinances for the prevention and abatement of contagious diseases. The councils may purchase or condemn all necessary lands within ten miles of the city for hospital purposes, waterworks, sewer carriage and outfall. They may make regulations to secure the general health of the city and to prevent and remove nuisances. The councils are authorized to regulate levees, wharves, landings, and depots. (Schram-Florida)
W70-04038

4B. Groundwater Management

UPCONING OF FRESH WATER-SEA WATER INTERFACE BELOW PUMPING WELLS, FIELD STUDY,
Ministry of Agriculture, Jerusalem (Israel). Hydrological Service; and Water Planning for Israel Ltd., Tel-Aviv.
S. Schmorak, and A. Mercado.
Water Resources Research, Vol 5, No 6, p 1290-1311, Dec 1969. 22 p, 24 fig, 1 tab, 11 ref.

Desriptors: *Saline water intrusion, *Aquifers, *Saline water-freshwater interfaces, *Water level fluctuations, Encroachment, Mixing, Diffusion, Dispersion, Groundwater movement, Pumping, Withdrawal, Mathematical models, Mathematical studies.
Identifiers: Nomograms, Cone of depression.

Field investigations on the upconing mechanism of interface under the influence of pumping were car-ried out to check the validity of the existing theoretical formulas, to study the salinization of pumped water as related to the position and characteristics of the interface, and to provide some analytic design procedures for skimming fresh water from above saline water bodies. Exist-ing theoretical formulas describing the upconing interface are in agreement with field results up to some critical rise of the interface, which seems to be approximately half the distance between the bottom of the well and the undisturbed interface. In addition, the use of the linear approximation for the dispersion pattern was justified as a first ap-proximation of the resultant transition zone. The salinization of the pumped water is probably caused by the intrusion of saline water above a critical depth. From correlation analysis, the salini-ty increase of pumped water is about 5 to 8% of the average salinity of the saline water intruded above the critical depth. Design procedures based both on theoretical formulas and field investigations are summarized in the form of nomograms. These nomograms were constructed on the assumption that the mixing mechanism for other geometries is similar to the observed one. (Knapp-USGS)
W70-03677

COST, PRECISION, AND VALUE RELATION-SHIPS OF DATA COLLECTION AND DESIGN ACTIVITIES IN WATER DEVELOPMENT PLANNING,
California Univ., Berkeley. Hydraulic Lab.
Stephen V. Allison.
Hydraulic Lab Tech Rep 6-27, Univ of Calif, Berkeley, Water Resources Center, Contrib No 120, May 1967. 142 p, 12 fig, 17 tab, 24 ref, 3 ap-pend.

Descriptors: *Mathematical models, *Optimiza-tion, *Water resources development, *Planning, *Decision making, Costs, Design, Data collections, Reservoirs, Budgeting, Constraints, Groundwater, California.

The problem of allocating available resources between the many diverse activities required in water development planning was presented. The problem could be formulated either in terms of maximizing overall precision subject to a fixed budget constraint, or minimizing the cost of attain-ing a specified degree of overall precision. A method of solution based on mathematical decision techniques was proposed and tested on the activi-ties involved in the modelling of groundwater reser-voirs. These concepts were used to build a mathe-matical model of the groundwater reservoir under-lying the southern end of the San Joaquin Valley in California. Optimal programs of collecting and manipulating the required data were defined and the applicability of mathematical decision techniques to the solution of these problems was demonstrated. (Thiuri-Cornell)
W70-03938

SELECTED ANALYTICAL METHODS FOR WELL AND AQUIFER EVALUATION,
Illinois State Water Survey Div., Urbana.
William C. Walton.
State Water Survey Div, Urbana, Ill, Bulletin 49, 1962. 81 p, 76 fig, 25 tab, 165 ref, 6 append.

Descriptors: *Mathematical models, *Aquifer characteristics, *Wells, *Hydrologic budget, *Il-linois, Groundwater, Simulation analysis, Op-timization, Geohydrologic units, Recharge, Pump-ing, Well spacing.
Identifiers: Image-well theory.

The practical application of selected analytical methods and mathematical models to well aquifer evaluation problems in Illinois was described. The subject matter included formulas, methods and models used to quantitatively appraise the geohydrologic parameters affecting the water-yielding capacity of wells and aquifers, and their response to heavy pumping. Several methods for

evaluating recharge rates involving flow-net analysis and hydrologic and groundwater budgets were described in detail. Optimum well spacings were estimated taking into consideration aquifer characteristics and economics. Simulation analysis techniques were used to formulate a model aquifer. The image-well theory and the appropriate groundwater formulas were used to construct a mathematical model which provided a means of evaluating the performance of wells and aquifers. (Thiuri-Cornell)
W70-03943

4C. Effects on Water of Man's Non-Water Activities

SOME EFFECTS OF SHADE COVER ON STREAM TEMPERATURE IN SOUTHEAST ALASKA,
Forest Service (USDA), Juneau, Alaska. Pacific Northwest Forest and Range Experiment Station.
For primary bibliographic entry see Field 05G.
W70-03819

THE WATER-RESOURCE COMMUNICATIONS GAP,
For primary bibliographic entry see Field 06D.
W70-03841

4D. Watershed Protection

WATERSHED DISTRICTS.

Tenn Code Ann secs 70-1801 thru 70-1849 (Supp 1969).

Descriptors: *Tennessee, *River basin commissions, *Watershed management, *Administrative agencies, Legislation, Drainage, Projects, Erosion control, Legal aspects, Construction, Maintenance, Water conservation, Land management, Water control, Water utilization, Drainage systems, Flood control, Water management (Applied), Reservoir construction, Reservoirs, Dikes, Levees, Recreation facilities.

Each watershed district is authorized to conserve soil and water and to retard floods and develop the water resources of the district. Watershed districts contract for the construction of proposed works and improvements. Watershed districts are empowered to construct drainage works or improvements and any works or improvements for the control, retention, diversion, or utilization of water. The watershed districts have authority to: retard runoff of water and soil erosion; construct ditches, channel improvements, dikes, levees, flood prevention reservoirs, water conservation reservoirs, irrigation reservoirs, facilities, parks, and other recreational facilities; and to repair, improve, and maintain any of said improvements or structures. A district may acquire land by gift, purchase or eminent domain. A district may acquire water rights and distribute or sell water for irrigation or other purposes. A district may provide recreational facilities. A study of the watershed area is conducted upon the incorporation of a watershed district. The matters to be determined by the court at a hearing on a petition for organization of a watershed district are enumerated. (Powell-Florida)
W70-03772

SEDIMENT YIELDS FROM THE CENTRAL COLORADO SNOW ZONE,
Forest Service (USDA) Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
For primary bibliographic entry see Field 2J.
W70-03821

WATERSHED DISTRICTS.

Ohio Rev Code Ann secs 6105.01 thru 6105.99 (Page Supp 1970).

Descriptors: *Ohio, *Watershed management, *River basin commissions, *Water management (Applied), State governments, Legislation, Administrative agencies, Water utilization, Channels, Water zoning, Water districts, Public utility districts, Conservation, Permits, Regulation, Channel improvement, Floodways.
Identifiers: Organization, Administrative procedures.

Terms dealing with watershed districts including water resources, beneficial use, channels and restricted channels are defined. Procedural details are outlined for establishing watershed districts. The board of directors of the district is empowered to: (1) review and recommend plans for the development of water resources; (2) recommend means of resolving conflicts between water users; (3) make studies and review plans for the development of water resources; (4) prepare a comprehensive plan for beneficial use of water to submit to state agencies; (5) counsel and advise public agencies on water problems; (6) enter contracts; (7) issue permits to restrict certain floodways; (8) issue construction permits for alteration of any floodway; and (9) petition for the creation of a conservancy district. Permission of the board is required before building any dam or boring any well. Certain areas may be designated as restricted channels. (Barnett-Florida)
W70-03917

SOIL AND WATER CONSERVATION DISTRICTS.

Wis Stat Ann secs 92.02-92.05, 92.08, 92.14, 92.15 (1957), as amended, (Supp 1969) 92.18, 92.20 (Supp 1969).

Descriptors: *Wisconsin, *Soil conservation, *Erosion control, *Administrative agencies, Legal aspects, Legislation, Agricultural engineering, Sediment control, Soil erosion, Water conservation, Soil management, Soil stabilization, Flood control, Operation and maintenance, Land tenure, Agriculture, Coordination, State governments, Watershed management, Surface runoff, Flood protection, Drainage.

The Soil and Water Conservation Committee is hereby established to conserve the soil resources of Wisconsin and to prevent damage to the soil from erosion, sediment, or floodwater. The Committee is directed to assist supervisors of soil conservation districts, approve and coordinate the activities of the districts, and disseminate information concerning soil conservation. County boards of supervisors may establish soil conservation districts. These districts are empowered to acquire property for watershed protection. flood prevention works, and recreational improvements. The districts may carry out measures for flood prevention or for agricultural phases of water control including the construction and operation of any necessary strucutres. Soil conservation districts are authorized to develop comprehensive plans for soil conservation and water utilization, enter lands to make surveys, and provide landowners with equipment, fertilizers, seeds and seedlings for soil conservation purposes. Provision is made in the act for the discontinuance of the districts. State agencies are instructed to cooperate with the districts in matters related to soil conservation. (Marsee-Florida)
W70-03918

MISSOURI SOIL AND WATER CONSERVATION DISTRICTS LAW.
For primary bibliographic entry see Field 03D.
W70-04041

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

USER TRIALS OF A SUBMERSIBLE WATER QUALITY RECORDING METER,
Ontario Water Resources Commission, Toronto. Great Lakes Survey Program.
M. D. Palmer.
Ontario Water Resources Commission, Great Lakes Surveys Program, 1969. 32 p, 6 fig, 2 tab, 5 ref, 5 append.

Descriptors: *Water quality, *Monitoring, *Instrumentation, Water pressure, Water temperature, Hydrogen ion concentration, Turbidity, Conductivity, Dissolved oxygen.
Identifiers: Water quality meters.

Two submersible recording water quality meters were field tested in the Great Lakes for accuracy and stability. These meters are battery operated and completely self-contained in a sealed stainless steel tube 16.5 cm in diameter by 76.2 cm long, weighing 21 kilograms. Temperature, pressure, real time, turbidity, pH, conductivity and dissolved oxygen are automatically evaluated every five minutes to one hour and recorded on magnetic tape. The information can also be transmitted to the water surface via line for telemetering. The meters have proven to be both flexible and reliable in water quality monitoring and model development programs. (Knapp-USGS)
W70-03662

DIEL AND SEASONAL VARIATIONS IN PHYSIOCHEMICAL LIMNOLOGY, SPEED RIVER, ONTARIO,
Guelph Univ. (Ontario).
For primary bibliographic entry see Field 02K.
W70-03861

COMPARISON STUDIES OF WINKLER VS. OXYGEN SENSOR,
Decatur Sanitary District, Ill.
Jeremiah F. Reynolds.
Journal Water Pollution Control Federation, Vol 41, No 12, p 2002-2009, Dec 1969. 8 p, 8 tab, 7 ref.

Descriptors: *Dissolved oxygen, *Water analysis, *Laboratory tests, Water quality, Instrumentation, Monitoring, Sewage treatment, Waste treatment.
Identifiers: Dissolved oxygen sensor.

Determinations of dissolved oxygen levels in wastewater treatment and effluent disposal are of great use in a number of ways. In-plant laboratory studies of using a polarographic oxygen sensor in comparison with the more common Winkler method were conducted. Advantages found were (a) the preparation and standardization of reagent solution are eliminated; (b) time spent in analysis is reduced; (c) the method is less tedious; and (d) correlation with the Winkler method is excellent. Laboratory experiences and data support these conclusions. (Knapp-USGS)
W70-03876

A BREAKTHROUGH IN THE TRACER STUDIES OF SEDIMENTATION TANKS,
Nova Scotia Technical Coll., Halifax. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05D.
W70-03922

SURFACE SLICKS AS CONCENTRATORS OF PESTICIDES IN THE MARINE ENVIRONMENT,
Miami Univ., Fla. Inst. of Marine Sciences.
Douglas B. Seba, and E. F. Corcoran.

Pesticides Monitoring Journal, Vol 3, No 3, p 190-193, 1969. 1 fig, 2 tab, 21 ref.

Descriptors: *Pesticides, *Surface waters, Oceans, Distribution, Florida, DDT, Winds, Dusts, Fish, Gulls, Plankton, Ecology, Productivity, Photosynthesis, Dieldrin, Aldrin, Flood control, Canals, Sampling, Farm wastes.
Identifiers: *Marine environment, *Slicks, *Concentrators, Biscayne Bay (Fla), Florida Current, DDE, Barbados (West Indies), Clupeidae, Engraulidae, Dolphins, Miami River (Fla), Turkey Point (Fla), Acetone, Butyraldehyde, Leptopel, Trade winds.

Slicks, or calm streaks on a rippled sea, are often seen on coastal waters and lakes and have been observed throughout the oceans. Formed by the ripple-damping action of a surface film of organic matter which occurs naturally on biologically reproductive waters, they are effective concentrators of persistent chlorinated pesticides and indicate presence of pesticides when they are undeterminable in surrounding waters. Because of high biological activity associated with slicks and their occurrence in oceans, these findings may be of considerable importance in understanding pesticide distribution in the marine ecosphere. Pesticides apparently exist in very low concentration in open oceans. Findings that acetone, butyraldehyde and 2-butanone, common to all samples, were barely concentrated, if at all, while pesticides were concentrated by several orders of magnitude, demonstrate that slick enrichment is a highly selective fractionation and may be of considerable ecological importance. Biological activity was very intense in water immediately under the slicks in comparison to surrounding water. Slicks could often be located by noting the feeding of sea gulls on fish. (Jones-Wisconsin)
W70-03953

IRON IN NATURAL WATERS--ITS CHARACTERISTICS AND BIOLOGICAL AVAILABILITY AS DETERMINED WITH THE FERRIGRAM,
Minnesota Univ., Minneapolis. Limnological Research Center.
For primary bibliographic entry see Field 02K.
W70-03954

ECOLOGY OF YEASTS FROM LAKE CHAMPLAIN,
Georgia State Coll., Atlanta; Louisiana State Univ., Baton Rouge; State Univ., Coll., Plattsburgh, N.Y.; and Vermont Univ., Burlington.
D. G. Ahearn, S. P. Meyers, W. L. Cook, and G. Hansen.
Antonie van Leuuwenhock, Vol 35, Supplement: Yeast Symposium, p D19-D20, 1969. 3 ref.

Descriptors: *Ecology, *Yeasts, New York, Vermont, Depth, Fungi, Nitrates, Temperature, Sampling, Effluents, Mills, Methane, Sludge, Iced lakes, Hydrography, Density, Pollutants, Oxygen, Light intensity, Thermal water.
Identifiers: *Lake Champlin (NY), Cryptococcus albidus, Rhodotorula rubra, Endospores, Rhodotorula glutinis, Aureobasidium pullulans, Cephalosporium, Hyalodendron, Rhinocladiella, Particulate matter, Candida krusei, Trichosporon penincillatum, Saccharomyces, Pichia, Trichoderma viride, Cellobiose, Hansenula californica, Hanseniaspora uvarum, Anionic alkylbenzene sulfonates, Cellulolytic fungi, Yeast distribution, Paper mill wastes, Water pollution identification.

Fifty-seven water samples collected from Lake Champlain, New York (August 1968) showed that yeasts and yeast-like fungi occurred randomly from the surface to depths of 115 meters, usually in concentrations yielding less than five colonies per 100 milliliters. Their highest concentrations generally occurred near the surface, but at some stations 15 to 70 cells/100 milliliters were found at intermediate and lowest depths. Most widespread fungi were representatives of Cryptococcus albidus, Rhodotorula rubra, R glutinis, and Aureobasidium pullulans while inshore sites appeared to possess distinct populations. Highest yeast densitities (more than 400 cells/100 milliliter) were observed at stations receiving heated effluents from a paper mill, with large numbers of a yeast not observed elsewhere. Animal associated yeasts were rarely isolated from urban areas. Regions influenced by urban sewage yielded predominantly Hansenula californica and Hanseniaspora uvarum. Monthly samples demonstrated that yeast populations were present throughout the year with maximal densities occurring during two successive winters, occasionally under iced conditions. No correlations were observed between yeast densities and various hydrographic conditions. Distributive patterns of certain species suggest the feasibility of using yeasts as indicators of specific water pollutants. (Jones-Wisconsin)
W70-03962

BACTERIAL GROWTH RATE IN THE SEA: DIRECT ANALYSIS BY THYMIDINE AUTORADIOGRAPHY,
Indiana Univ., Indianapolis. Dept. of Microbiology.
For primary bibliographic entry see Field 05C.
W70-03968

5B. Sources of Pollution

STATISTICAL EVALUATION OF SALINITY AND NITRATE CONTENT AND TRENDS BENEATH URBAN AND AGRICULTURAL AREA-FRESNO, CALIFORNIA,
Agricultural Research Service, Fresno, Calif. Groundwater Recharge Field Station.
Harry I. Nightingale.
Groundwater, Vol 8, No 1, p 22-28, Jan-Feb 1970. 7 p, 6 fig, 5 tab, 8 ref.

Descriptors: *Water pollution sources, *Groundwater, *California, *Nitrates, *Salinity, Water wells, Aquifers, Irrigation water, Fertilizers, Urbanization, Statistical methods, Surveys, Conductivity, Farm wastes, Regression analysis.
Identifiers: Fresno (Calif).

The salinity and nitrate content of well water for an urban zone (Fresno-Clovis, California) and the immediate surrounding irrigated agricultural zone were compared using data for 1950 through 1967. Time trends in these water chemical properties were evaluated statistically by dividing the 18-year period into three 6-year periods. Salinity of the urban zone groundwater has increased with time, whereas that of the agricultural zone has fluctuated considerably. Possible reasons for changes are discussed. The nitrate content of well water from both zones has increased with time, with water from the agricultural zone showing the greatest increase. (Knapp-USGS)
W70-03649

CONSERVING RESOURCES AND MAINTAINING A QUALITY ENVIRONMENT,
Agricultural Research Service, Beltsville, Md. Soil and Water Conservation Research Div.
Cecil H. Wadleigh, and Clarence S. Britt.
Journal of Soil and Water Conservation, Vol 24, No 4, p 172-175, Oct 1969. 4 p, 4 ref.

Descriptors: *Water resource development, *Water pollution, *Eutrophication, Government supports, Soil conservation, Industrial wastes, Municipal wastes, Fertilizers, Pesticides, Soil erosion, Animal wastes, Economics, Nitrogen, Water conservation.
Identifiers: *Soil runoff, Livestock.

Some of the problems involved in natural resource conservation are presented, with particular emphasis on the water pollution caused by agricultural runoff and livestock production. It is pointed out that the economics of the farming and livestock industry are often in conflict with the conservationists' interests. It is suggested that the Dept of Agriculture adopt a cost-sharing program to encourage solutions to some of the problems. The article emphasizes the dangers of eutrophication induced by animal wastes. The author concludes with a statement of some of the accomplishments of the conservation movement in the area of soil and water resources. (Murphy-Rutgers)
W70-03823

THERMAL DISCHARGE AND WATER QUALITY IN A 1,500-ACRE RESERVOIR,
Missouri Univ., Columbia. Dept. of Zoology; and Missouri Dept. of Conservation. Fisheries Div.
For primary bibliographic entry see Field 05C.
W70-03845

NITRATE CONTENT OF THE UPPER RIO GRANDE AS INFLUENCED BY NITROGEN FERTILIZATION OF ADJACENT IRRIGATED LANDS,
Agricultural Research Service, Riverside, Calif. Salinity Lab.
C. A. Bower, and L. V. Wilcox.
Soil Science Society America Proceedings, Vol 33, No 6, p 971-973, Nov-Dec 1969. 3 p, 1 fig, 3 tab, 11 ref.

Descriptors: *Water pollution, *Fertilizers, *Nitrates, Water quality, Soils, Nitrogen, Water pollution sources, Streams, Irrigated land, Irrigation.
Identifiers: Upper Rio Grande.

Over a 30-year period the application of nitrogen fertilizer to three irrigated areas adjacent to the Upper Rio Grande increased from a very low to a high level. At the same time, the overall nitrate-nitrogen concentration of the river did not increase. It is concluded that no significant stream pollution by nitrate-nitrogen has occurred from the nitrogen fertilizer. (Carstea-USGS)
W70-03849

USE OF CHEMICAL AND RADIOACTIVE TRACERS AT THE NATIONAL REACTOR TESTING STATION, IDAHO,
National Reactor Testing Station, Idaho Falls, Idaho.
For primary bibliographic entry see Field 02F.
W70-03893

ENVIRONMENTAL TRITIUM STUDIES AT THE NATIONAL REACTOR TESTING STATION,
Atomic Energy Commission, Idaho Falls, Idaho.
D. B. Hawkins, and B. L. Schmalz.
In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 157-158, 1967. 2 p.

Descriptors: *Tritium, *Radioisotopes, *Radioactivity techniques, *Tracers, Nuclear reactors, Environmental effects, Water pollution, Lakes, Forecasting, Statistical methods, Idaho.
Identifiers: *Tritium contamination, National Reactor Testing Station, Salt Lake City.

The extent to which the National Reactor Testing Station (NRTS) in southeastern Idaho has contributed to the over-all tritium contamination of the environmental waters is discussed. The total quantity of tritium that fell on this region was similar to the tritium concentration in Salt Lake City, Utah. It was concluded that NRTS operations have not contributed noticeably to the over-all tritium contamination of this region. Tritium was used in calculating the average rate of groundwater movement at the NRTS; the movement averages about 13 ft/day. A log-normal plot of the cumulative percent frequency of tritium versus time was found to be useful in predicting the mean velocity of groundwater. (Carstea-USGS)
W70-03898

THE USE OF A TRACER TEST TO VERIFY AN ESTIMATE OF THE GROUNDWATER VELOCITY IN FRACTURED CRYSTALLINE ROCK AT THE SAVANNAH RIVER PLANT NEAR AIKEN, SOUTH CAROLINA,
Geological Survey, Aiken, S.C.
For primary bibliographic entry see Field 02F.
W70-03899

USE OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL STUDIES: CHAPTER III,
Northeastern Univ., Boston, Mass. Dept. of Civil Engineering.
Alvin Goodman, and Richard J. Tucker.
FWPCA, Research Series Report ORD-6, p 19-41, July 1969. 2 fig, 9 tab.

Descriptors: *Mathematical models, *Water quality control, *Sewage treatment, *Optimization, *Decision making, *Biochemical oxygen demand, Dissolved oxygen, Simulation analysis, Computers, Economics, Design.
Identifiers: Sensitivity analysis.

A steady state mathematical model was applied to a study of a water pollution control program. Input data for the steady state model included hydraulic constants and stream purification rate constants for each reach of the river, population and economic information for each community and assumptions with respect to administrative decisions. For various levels of sewage treatment for each community, a computer program evaluated water quality throughout the length of the stream, and the costs and benefits of the water pollution control program. An optimizing routine determined desirable levels of sewage treatment for each river section in accordance to a specified water quality criteria. A sensitivity analysis by computer simulation was carried out, in which the biochemical oxygen demand and dissolved oxygen parameters were investigated within a possible range. The resulting river water qualities, degrees of treatment, and economic effects, in combination, formed a picture of how different assumptions might affect the ultimate design. (See Vol. 3, No. 9, Field 5C, entry W70-03488). (Thiuri-Cornell)
W70-03933

USES OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL STUDIES: CHAPTER IV,
Northeastern Univ., Boston, Mass. Dept. of Civil Engineering.
Alvin Goodman.
FWPCA, Research Series Report ORD-6, p 42-64, July 1969. 23 p, 5 fig.

Descriptors: *Mathematical model, *Water pollution control, *Biochemical oxygen demand, *Dissolved oxygen, *Waste assimilative capacity, Coliforms, Chlorides, Upstream, Time, Unsteady flow, Variability.
Identifiers: Unsteady state model.

A time varying mathematical model was developed and used in a water pollution study. The objective of the model was to make maximum use of data obtained from records and field surveys of the Merrimack River, and to produce the results needed to examine the effectiveness of water pollution control programs. Techniques were developed for tracing a time profile of flow and quality in terms of biochemical oxygen demand, dissolved oxygen, coliforms, and chlorides, while the upstream discharge, water temperature, and solar radiation were changing. The time varying model was used to investigate the effectiveness of an assumed configuration of treatment plants when the stream's assimilative capacity varied with distance and time. (See Vol. 3, No. 9, Field 5C, entry W70-03488). (Thiuri-Cornell)
W70-03934

CARBON SOURCES IN ALGAL POPULATIONS AND ALGAL COMMUNITY STRUCTURE,
Oklahoma Water Resources Research Inst., Stillwater.
Troy C. Dorris.
Available from the Clearinghouse as PB-189 523, $3.00 in paper copy, $0.65 in microfiche. Research Project Technical Completion Report, Oklahoma WRSIC Institute (1969). 10 p, 1 fig, 2 tab. OWRR Project No B-005-OKLA.

Descriptors: *Carbon, *Algae, *Population, *Biological communities, Effluents, Eutrophication, Phytoplankton, Decomposing organic matter, Oklahoma, Reservoirs, Sampling, Industrial wastes, Municipal wastes, Sewage, Adsorption, Activated carbon, Filters, Seasonal, Stratification, Biochemical oxygen demand, Carbon radioisotopes, Detergents, Antifreeze, Oxidation, Photosynthesis, Oil wastes, Garbage dumps, Pigments, Dams, Physicochemical properties, Chlorophyll.
Identifiers: Arkansas River (Okla), Tulsa (Okla), Pollution, Fossil, Cimarron River (Okla), Bixby (Okla), Keystone Reservoir (Okla), Carotenoids.

A portion of a study to determine source and distribution of organic compounds in the Keystone Reservoir, Oklahoma, and the development of phytoplankton populations in response to eutrophication processes resulting from decomposition of organic compounds in effluents entering the Cimarron arm of the reservoir is described. Organic compounds from industrial and municipal sewage effluents were sampled by adsorption on activated carbon filters at six stations to develop information on seasonal changes in quantity and nature of organic compounds, effect of stratification on movement and changes of compounds, and pollution of the Arkansas River by effluents from Tulsa. The effort to identify particular compounds, trace their progress through the reservoir and determine extent of their degradation by passage through the reservoir is expected to be completed with further study. Extraction of adsorbed compounds from carbon filters has been accomplished but data were incomplete. Phytoplankton studies on the Cimarron arm of the reservoir were designed to study effects of eutrophication of the water by domestic and industrial effluents. The full spectrum of photosynthetic and other pigments was measured as each sample was taken. Efforts were made in species identification. (Jones-Wisconsin)
W70-04001

5C. Effects of Pollution

BIOLOGICAL EFFECTS OF HANFORD HEAT ON COLUMBIA RIVER FISHES - A REVIEW,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.
R. E. Nakatani.
US Atomic Energy Commission, BNWL-SA-1682, 1968. 24 p, 12 fig, 1 tab.

Descriptors: *Heated water, *Temperature, *Nuclear reactors, *Fish behavior, Salmon, Trout, Cooling water, Thermal pollution, Path of pollutants, Fish, Chinook salmon, Thermal powerplants, Columbia River.
Identifiers: Hanford reactor, Priest Rapids Dam.

To obtain information on the effects of heated discharges from the reactors at Hanford, Washington, on fish in the Columbia river, the temperature tolerance of young chinook salmon exposed to 7 different temperatures was investigated; the lowest temperature was similar to the average river temperature at Priest Rapids dam, and it was found that increased temperature resulted in increased body weight. Adult salmon and steelhead trout were fitted with sonic tags so that their behavior in the vicinity of the waste-water plumes could be detected; the results showed no evidence of a temperature block, but the fish tended to migrate upstream along the opposite bank from the reactor sites. (Rietveld-Vanderbilt)
W70-03721

THE RELATION OF TEMPERATURE TO OXYGEN CONSUMPTION IN THE GOLDFISH,
Toronto Univ. (Ontario).
F. E. J. Fry, and J. S. Hart.
The Biological Bulletin, Vol 94, No 1, p 66-77, 1948. 6 fig, 2 tab, 17 ref.

Descriptors: *Oxygen requirements, *Temperature, Fish, Metabolism, Fish behavior, Oxygen.
Identifiers: *Goldfish, Standard metabolism, Maximum oxygen uptake.

Two levels of oxygen uptake in the goldfish were measured at temperatures from 5 deg C to 35 deg C. The lowest point in the resting metabolism in the daily cycle was taken to be the standard rate and was measured over levels of oxygen high enough to avoid any dependence of the rate on oxygen tension. The maximum steady rate of oxygen uptake found when the fish were stimulated to activity in a rotating chamber was measured over a series of oxygen tensions down to the asphyxial level. The standard rate continued to increase with temperatures up to 35 deg C, while the maximum rate was found by interpolation to reach its highest value at about 30 deg C and to remain steady or decrease slightly at higher temperatures. The maximum rate of oxygen uptake became dependent upon the oxygen tension between 15 and 40 mm Hg, depending upon the temperature. Oxygen tensions at which the maximum oxygen uptake met only the needs of the standard metabolism were estimated to be between 4 and 25 mm Hg over that same range of temperatures. The difference between the maximum and standard metabolic rates was correlated with the rate at which goldfish can swim steadily at the various temperatures, and it was concluded that the drop in the sustained swimming rate of the goldfish at temperatures from 30 deg C to 38 deg C was probably due to a decrease in the metabolism available for external work rather than to the thermal destruction of enzymes. (Speakman-Vanderbilt)
W70-03722

THE EFFECT OF DIETARY FAT ON THE HEAT TOLERANCE OF GOLDFISH (CARASSIUS AURATUS),
British Columbia Univ., Vancouver. Dept. of Zoology.
W. S. Hoar, and J. E. C. Dorchester.
Canadian Journal of Research, Sect D, Zool Sci, Vol 27, p 85-91, 1949. 3 fig, 1 tab, 12 ref.

Descriptors: *Heat resistance, *Diets, Fish, Temperature, Fishkill, Mortality, Fish diets.
Identifiers: *Goldfish, Fats, Unsaturation.

Three groups of goldfish were acclimated at 20 deg C and fed diets containing 25% fat. The diets for the three groups differed in the degree of unsaturation of these fats. Pilchard oil, herring oil, and lard were the fats used. Heat tolerance of the fish was then tested by holding them at a constant temperature of 36 deg C and observing the time of death. Variations in the ability of the groups to withstand high temperature were correlated with differences in the degree of unsaturation of their extracted fats. The degree of unsaturation of the herring oil diet was very close to that of the fats of the goldfish prior to feeding and no change in the value for fish fed on this diet was observed. Each of the other two diets changed the degree of unsaturation of the goldfish fats by approximately 54% of the maximum theoretical change. These changes modified the heat resistance of the fish. The change in heat resistance resulting from the lard diet was equivalent to a change in acclimation temperature from 20 deg C to 24 deg C. The degree of modification of heat tolerance, however, cannot be strictly correlated with the degree of change of unsaturation of fats and it is concluded that factors associated with differences in melting point rather than melting point of the fat itself are probably involved in heat resistance. When the rates of death of the fish during the first 75 minutes at 36 deg C were compared, no statistical difference between the behavior of the samples fed the fish-oil diets existed, but the sample fed the solid diet (lard) was distinct. (Speakman-Vanderbilt)

W70-03723

GROWTH OF LARGEMOUTH BASS FRY AND VARIOUS TEMPERATURES,
Arkansas Univ., Fayetteville. Dept. of Zoology.
Kirk Strawn.
Transactions of the American Fisheries Society, Vol 90, No 3, p 334-335, July 1961. 1 fig, 2 ref.

Descriptors: *Temperature, *Growth rates, Fry, Fish eggs, Fish management, Productivity, Fish, Mortality, Fishkill.
Identifiers: *Largemouth bass.

Largemouth bass (Micropterus salmoides) eggs which had begun to hatch were taken from hatchery ponds and placed in aerated jars maintained at 15.0 deg, 17.5 deg, 20.0 deg, 22.5 deg, 25.0 deg, 27.5 deg, and 30.0 deg C. Fry were then removed from the tanks, beginning on the first day they started feeding. Samples of 10 fry from each temperature were preserved in 5 percent formalin. The growth rate of the fry at each temperature was determined by measuring total length in millimeters. Growth rate increased with increasing temperature, with the maximum occurring at 27.5 deg and 30.0 deg C. The 15.0 deg C fry did not feed and all died of starvation. (Speakman-Vanderbilt)
W70-03733

THERMAL DISCHARGE AND WATER QUALITY IN A 1,500-ACRE RESERVOIR,
Missouri Univ., Columbia. Dept. of Zoology; and Missouri Dept. of Conservation. Fisheries Div.
E. R. Brezina, Robert S. Campbell, and James R. Whitley.
Journal Water Pollution Control Federation, Vol 42, No 1, p 24-32, Jan 1970. 9 p, 2 fig, 4 tab, 26 ref.
OWRR Proj No B-001-MO.

Descriptors: *Thermal pollution, *Reservoirs, *Missouri, Thermal powerplants, Stratification, Thermal stratification, Water temperature, Ecology, Aquatic habitats, Turbidity, Dissolved oxygen, Water quality.
Identifiers: Montrose Reservoir (Mo).

This study reports on the effects of thermal discharges from a 525,000-kw fossil-fueled steam-electric plant into a 4.5 billion gal reservoir with a mean depth of 8.2 ft, in central Missouri. The most significant effect observed during the 21-month study was temperature elevation which averaged 5 deg to 8 deg C with a maximum difference in mean temperatures of 10 deg C. Differences in DO were always less than 1 mg/l. The area heated by the thermal discharge is influenced by the direction of the prevailing wind. The relatively shallow depth of the reservoir with the wind effects minimizes with thermal stratification and maintains suspension of fine particles. Runoff water maintains the high level of turbidity in the reservoir. There was no significant difference in living matter present in the heated and unheated areas of the reservoir. (Knapp-USGS)
W70-03845

RELATIVE TOXICITIES AND DISPERSING EVALUATIONS OF ELEVEN OIL DISPERSING PRODUCTS,
Washington State Water Pollution Control Commission, Olympia. Dept. of Fisheries.
Harry B. Tracy, Ronald A. Lee, Charles E. Woelke, and Gene Sanborn.
Journal Water Pollution Control Federation, Vol 4, No 12, p 2062-2069, Dec 1969. 1 fig, 4 tab, 4 ref.

Descriptors: *Biossay, *Dispersion, *Emulsifiers, *Toxicity, *Oil, Aquatic environment, Estuaries, Fish, Larvae.
Identifiers: *Pacific Northwest, *Dispersant, *Oil spills, Washington freshwater bioassays, Saltwater bioassays, In-situ bioassays, Group-number.

In a joint effort to provide information concerning oil dispersing products to organizations involved in oil spill control in the Pacific Northwest, the State of Washington conducted bioassays and evaluation experiments on eleven selected, commercial, U.S. oil dispersants. The test organisms for the toxicity were: steelhead fingerling, Pacific oyster larvae, and coho salmon fingerling dispersing evaluations were made visually. Each dispersant was scored on each test and from these scores, group assignments were made. Dispersant selections were determined from a group-number combination method. Thus, a score of one was given for a comparatively high dispersing property and a relatively low toxicity on the bioassays; a score of four was awarded for the converse of the foregoing factors. That is, dispersants bearing low group-number combinations provided least threat to the aquatic environment and more efficient dispersion. Selection of dispersant depends on size and location of spill. (D'Arezzo-Texas)
W70-03913

A METHOD FOR PREDICTING THE EFFECTS OF LIGHT INTENSITY ON ALGAL GROWTH AND PHOSPHOROUS ASSIMILATION,
Abbott Labs., North Chicago, Ill. Dept. of Sanitary Engineering; and Michigan Univ., Ann Arbor.
H. S. Azad, and J. A. Borchardt.
Journal Water Pollution Control Federation, Vol 41, No 11, Part 2, p R392-R404, Nov 1969. 10 fig, 14 ref.

Descriptors: *Algae, *Chlorella, *Scenedesmus, *Light, Phosphorus, Photosynthesis, Light intensity, Stabilization, Ponds, Penetration, Absorption.
Identifiers: *Beer-Lambert Law, *Fixed-density studies, *Fixed-light tests, *Effective-average-light-intensity, Photo-electric turbidostat, Light extinction coefficient, Algal cell density.

Research is devoted to obtaining a better understanding of the interaction of light intensity on the rate of algal growth, and phosphorous uptake by algae in an aqueous environment. Green Algae Chlorella and Scenedesmus were grown under a carefully controlled environment. The light intensity was varied by two methods: (1) maintenance of a constant biomass density by using a photo-electric-turbidostat apparatus providing for variable light intensity control at the sources; (2) maintenance of the incident luminous energy at a constant value providing for variable algae cell density. The Beer-Lambert expression (I sub 0/I = e to the power CAD) failed to predict the light penetration data. However, an empirical relationship in which the familiar coefficient of extinction was replaced by an exponential variable did provide the necessary agreement. Algal growth rate vs. the culture-face-light intensity yields a curve that implies the existence of a light saturation point. When growth rate vs effective average light intensity was plotted, a more logical effect of light was produced. (D-'Arezzo-Texas)
W70-03923

BACTERIAL POPULATION OF HUMIFIED LAKES (IN RUSSIAN),
Akademiya Nauk SSSR, Leningrad. Zoologicheskii Institut.
For primary bibliographic entry see Field 02H.
W70-03948

PHYTOPLANKTON NUTRIENT ENRICHMENT EXPERIMENTS OFF BAJA CALIFORNIA AND IN THE EASTERN EQUATORIAL PACIFIC OCEAN,
Scripps Institution of Oceanography, La Jolla, Calif.
William H. Thomas.
Journal Fisheries Research Board of Canada, Vol 26, No 5, p 1133-1145, 1969. 2 fig, 7 tab, 19 ref.

Descriptors: *Phytoplankton, *Inorganic compounds, Nitrogen, Phosphates, Aquatic life, Vitamins, Ocean currents, Nutrient requirements, Nutrients.
Identifiers: EDTA, Carbon-14, Baja California, Eastern Equatorial Pacific Ocean, Oceans, Coastal upwelling, EASTROPAC expeditions.

Results are reported of ten enrichment experiments carried out with natural illumination and prolonged incubation in the eastern equatorial Pacific Ocean. Carbon-14 uptake or changes in chlorophyll were used to assess the effects of enrichment in all experiments. The first five, between June 1964 and November 1966, indicated the most important limiting nutrient in oligotrophic water was nitrogen. Experiments were again carried out during January-March 1967, as the initial part of Expedition EASTROPAC, when areas of nutrient-rich waters were also sampled. These nutrient-rich waters were caused by seasonal upwelling (such as off Baja California), nonseasonal upwelling (the Costa Rica Dome), and of upwelling plus advection from the Peru Current (the nutrient-rich equatorial area). Tests of nutrient-poor waters confirmed that the primary nutrient limiting the population was nitrogen. In nutrient-rich water from equatorial upwelling, limitation by any specific nutrient were not found. Single additions of trace metals and vitamins stimulated chlorophyll synthesis; however, marked changes suggest that the populations in nutrient-rich waters were not nutrient limited. (Haskins-Wisconsin)
W70-03949

EXCRETION OF DISSOLVED ORGANIC COMPOUNDS BY AQUATIC MACROPHYTES,
Michigan State Univ., Hickory Corners. W. K. Kellogg Biological Station.
Robert G. Wetzel.
BioScience, Vol 19, No 6, p 539-540, 1969. 2 tab, 13 ref.

Descriptors: *Aquatic microorganisms, Carbon assimilation, Lakes, Photosynthesis, Organic compounds, Marl, Lakes.
Identifiers: *Najas flexilis, Carbon-14, Ionization, Chamber-electrometer, Photosynthetic carbon fixation, Aquatic macrophytes.

Interactions of inorganic parameters on rates of photosynthesis and excretion of total dissolved organic compounds (TDOC) by submerged angiosperm typical of marl lakes were studied. Photosynthetic rates were determined by uptake of carbon-14 labeled bicarbonate as determined by combustion to radiocarbon dioxide-14 and analysis in the gas phase. Mean rates of photosynthetic carbon fixation by Najas flexilis and rate of percentage of DOC excreted to the mean photosynthetic rate in response to increasing concentration of calcium, magnesium, sodium, and potassium are calculated. Photosynthetic rates consistently increased with increasing concentrations of calcium ions in the range 0.20 milligram/liter, but exhibited marked decrease at higher concentrations. DOC synthesized demonstrated a progressive reduction in relation to photosynthetic fixation. Photosynthetic rates were markedly reduced by increasing concentration of magnesium ions to and above those normally formed in typical marl lakes. DOC excretion was high in the range of 0-4 milligram/liter magnesium ions and particularly at concentrations above 15 milligram/liter. High rates of DOC loss prevailed in absence of sodium ions; rates decreased significantly at low levels of 1-3 milligram/liter, but increased markedly with higher concentrations of sodium ions. This pattern closely paralleled the photosynthetic rates. (Haskins-Wisconsin)
W70-03951

DISTRIBUTION, CHARACTERIZATION, AND NUTRITION OF MARINE MICROORGANISMS FROM THE ALGAE POLYSIPHONIA LANOSA AND ASCOPHYLLUM NODOSUM,
McGill Univ., Montreal (Quebec). Dept. of Microbiology and Immunology; and New Brunswick Univ., Fredericton. Dept. of Biology.
E. C. S. Chan, and Elizabeth A. McManus.
Canadian Journal of Microbiology, Vol 15, No 5, p 409-420, 1969. 5 fig, 4 tab, 38 ref.

Descriptors: *Marine microorganisms, *Algae, *Nutrient requirements, *Distribution, Bacteria, Sampling, Sea water, Seasonal, Pseudomonas,

Temperature, Amino acids, Intertidal areas, Carbohydrates, Yeasts, Enzymes, Cultures, Hydrogen sulfide, Electron microscopy, Biochemistry, Vitamins, Epiphytology.
Identifiers: *Polysiphonia lanosa, *Ascophyllum nodosum, Vibrio, Flavobacter, Escherichia, Sarcina, Staphylococcus, Achromobacter (Alkaligenes), Rhodotorula, Growth factors, Colonial morphology, Cellular morphology, Flagellation, Iodine test, Gram reaction, Cytophaga, Proteus, Serratia, Bay of Fundy (Canada), Rhyzoids.

Bacterial populations of two associated littoral marine algae, Polysiphonia lanosa and Ascophyllum nodosum, and their environmental seawater were studied quantitatively. Samplings showed numbers of bacteria on P lanosa and in the seawater remained relatively constant while those on A nodosum decreased in mid-summer, after an apparent spring maximum, and then gradually increased. Pure cultures of 25 isolates were studied and identified to genus level. There was a preponderance of the genera Vibrio and Flavobacter (8 each). Three of the Escherichia group, 2 of Pseudomonas, one each of genera Sarcina, Staphylococcus, and Achromobacter (or Alkaligenes), and a pink yeast (Rhodotorula) made up the other isolates. Optimum temperature for growth of most isolates was around 21C. Five isolates failed to grow at 30C; 20 did not grow at 37C; of the 5 growing at 37C, development was feeble in every case but one. Studies on gross nutritional requirements of the marine organisms showed that 22 of 25 isolates required a supplement of amino acids in growth medium. Two were able to grow on basal medium; one isolate grew only in a medium supplemented with growth factors in addition to amino acids (Jones-Wisconsin)
W70-03952

AVAILABILITY OF MUD PHOSPHATES FOR THE GROWTH OF ALGAE,
H. L. Golterman, C. C. Bakels, and J. J. Jakobs-Mogelin.
Verhandlungen der Internationalen Vereinigung fur theoretische und angewandte Limnologie, Vol 17, p 467-479, 1969. 10 fig, 3 tab, 10 ref, discussion.

Descriptors: *Eutrophication, *Mud (Lake), *Phosphorus, *Aquatic algae, *Bioassay, Scenedesmus, Phosphates, Water pollution sources.
Identifiers: *Dutch lakes, *Allochthonous phosphates, Ultra-violet light sterilization, Asterionella, Scenedesmus obliquus, Growth constats, River Rhine.

Avilability of lake muds phosphorus to algae was determined by employing Scenedesmus obliquus as test organism. Culture solutions contained potassium phosphate in different concentrations, calcium phosphates, iron phosphates, and lake muds as the only source of phosphorus. The growth constants were obtained from cultures with inorganic phosphates. Based on the number of cells of Scenedesmus, a considerable fraction of mud phosphorus was available to algae. Depending on the origin of sediment, from 7 to 30.5% of phosphorus was used for cell growth. Sterilization with ultra-violet light had no significant influence on the growth of organisms. Results suggested that Scenedesmus is utilizing largely allochthonous phosphates, leaving sufficient supply of inorganic phosphorus for Asterionella algae. (Wilde-Wisconsin)
W70-03955

MARINE RADIOECOLOGY,
Washington State Univ., Pullman; and Nevada Operations Office (AEC), Las Vegas.
Eldon Edmundson, Jr., Vincent Schultz, and Alfred W. Klement, Jr.
US Atomic Energy Commission, Div of Technical Information, TID-3917, Biology and Medicine (TID-4500), Oct 1969. 127 p.

Descriptors: *Radioecology, *Radioactivity, *Bibliographies, Oceanography, Aquatic environments, Estuaries, Water pollution sources, Water pollution effects, Radioactive waste disposal, Radioactivity effects, Brackish water, Fallout.
Identifiers: *Marine studies, Biological oceanography, Laboratory studies, Field studies, Anadromous species, Catadromous species, Radioactive contamination, Radioecological concentration.

Interest continues to grow in marine radioecology, a diverse and widely ranging subject, about which literature is relatively extensive and scattered. It is believed that this bibliography of 1450 entries includes most major Non-Russian publications, other than progress reports in the field. Dates of publication of documents cited span the period 1908-1969, with approximately 59% dated 1960 or later. The Japanese literature is extensively covered. Additional foreign-language coverage includes Italian, French, German, Finnish, Chinese, and Korean. (Eichhorn-Wisconsin)
W70-03956

RELATION BETWEEN FILTERING RATE, TEMPERATURE, AND BODY SIZE IN FOUR SPECIES OF DAPHNIA,
Yale Univ., New Haven, Conn. Osborn Memorial Labs.
Carolyn W. Burns.
Limnology and Oceanography, Vol 14, No 5, p 693-700, 1969. 2 fig, 2 tab, 18 ref, discussion.

Descriptors: *Grazing, *Temperature, *Daphnia, Physiological ecology, Lakes, Environmental effects, Water pollution effects, Epilimnion, Connecticut, Euglena, Chlamydomonas, Phosphorus radioisotopes, Regression analysis, Algae, Ponds, Predation.
Identifiers: *Filtering rate, *Body size, *Comparative studies, Daphnia schodleri, Daphnia pulex, Daphnia galeata mendotae, Daphnia magna, Selenastrum, Rhodotorula, Temperature coefficients, North America, Central America, Rate equations, Analysis of variance, Food concentration, Mexico, Predictive equations, Zoogeography, Thermobiology.

Filtering rates (F) of cladocerans can be measured by determining their uptake of radiophosphorus from labelled food. F of four daphnid species, fed on labelled yeast, were measured at temperatures of 15C, 20C, and 25C. Maximum F increased with rising temperature and body size in all species, but a general equation relating F to body length (L) could not be derived. Body weight (W) can be deduced from L with equations of type, $\log W = \log a + b \log L$, where a and b are empirically derived coefficients. Data are tabulated for a and b of all species, considered collectively and individually. F, expressed in milliliters water filtered per hour/milligram daphnid dry weight, differed among species. F for adult Daphnia schodleri (DS) and Daphnia pulex (DP) were similar, and at 20C, were slightly higher than at 15C or 25C. F for Daphnia magna (DM) and Daphnia galeata mendotae (DG) increased with increasing temperature. Temperature coefficients (Q-10) for F, changing in range 15-25C were, for four species: DG-2.71, DM-2.38, DP-0.94, DS-0.90. Thermal determinants of maximum F may determine success of daphnids occupying warm epilimnetic lacustrine waters in summer. (Eichhorn-Wisconsin)
W70-03957

UPTAKE OF GLYCINE BY BLUE-GREEN ALGAE,
California Univ., Irvine. Dept. of Organismic Biology; and Gujarat Univ., Ahmadabad (India). Botany Div.
G. C. Stephens, B. S. Vaidya, and O. P. Saxena.
Indian Journal of Experimental Biology, Vol 7, No 1, p 43-44, 1969. 1 fig, 3 ref.

Descriptors: *Cyanophyta, *Amino acids, Carbon radioisotopes, Radioactivity, Carbon dioxide, Chlorophyta, Absorption, Chromatography, Metabolism.
Identifiers: *Uptake, *Glycine, Oscillatoria jasorvensis, Gloeotrichia pisum, Microcystis aeruginosa, Spirogyra, Assimilation, Autoradiography, Heterotrophy.

Uptake of glycine-carbon-14 was measured in three species of blue-green algae: Oscillatoria jasorvensis, Gloeotrichia pisum, and Microcystis aeruginosa. Radioactivity in breis of Oscillatoria increased with increasing incubation time in glycine-carbon-14 solution (100 microns carbon/liter distilled water). Uptake rate increased with the increasing ambient glycine-carbon-14 concentration, maximum velocity of uptake being 0.0000004 moles/gram tissue per hour. Radio-activity lost from the medium is measured quantitatively as radioactive carbon dioxide and as much as 15% of radioactivity is lost from glycine-carbon-14 at 0.0000009 moles/liter. Most experiments were conducted with Oscillatoria, the easiest organism to use. Results indicate positive absorption and assimilation of glycine by blue-green algae compared to negative results with green alga, Spirogyra. Blue-green algae investigated are capable of obtaining and utilizing glycine from dilute solution; the glycine obtained can enter oxidative pathways as indicated by carbon dioxide production or may act as a substrate for synthesis. The potential significance of this capacity of heterotrophy depends on the level of free amino acids in the environment. (Jones-Wisconsin)
W70-03958

CONCEPTS OF EUTROPHICATION AND TROPHIC BIOLOGY,
Oesterreichische Akademie der Wissenschaften, Vienna. Lunz Biological Station.
For primary bibliographic entry see Field 02H.
W70-03959

THE ROLE OF PHOSPHATE-SOLUBLE BACTERIA IN THE ASSIMILATION OF ROCK PHOSPHATE PHOSPHORUS UNDER CONDITIONS OF MONOBACTERIAL CULTURE (IN RUSSIAN),
Moskovskaya Sel'skokhozyaistvennaya Akademiya (USSR).
I. T. Geller.
Izvestiya Akademii Nauk SSSR, Ser Biol, No 1, p 171-175, 1969. 4 tab, 15 ref.

Descriptors: *Bacteria, *Phosphorus, *Phosphates, *Cultures, Soil bacteria, Oats, Corn (Field), Organic acids, Fertilizers, Pseudomonas.
Identifiers: Peas, Sugars, Phosphate-dissolving, Pseudomonas fluorescens, Organic excretions.

Experiments were conducted concerning effect of phosphate-dissolving bacteria and a soil bacteria mixture on availability of phosphorus in minerals to peas and oats. Greenhouse trials with sterilized and inoculated media and test plants whose root systems had different capacity for dissolving phosphates indicated monoculture of Pseudomonas fluorescens exerted a positive influence on peas and oats growth, increasing utilization of phosphate mineral. Pea plants inoculated with soil suspension grew less than control plants. Total phosphorus content was higher in bacterized cultures. Apparently reduced growth of inoculated plants was caused by bacteria-produced toxic substances disrupting normal plant development. Bacteria influence on solubility of phosphate minerals was determined from composition of organic excretions of roots. Peas and oats, during initial growth stages, excreted equal amounts of organic substances; corn, also investigated, excreted more. Root excretions of corn were largely sugars and small amounts of amino-nitrogen. Oats gave the maximum content of amino-nitrogen in dry matter. Pea root excretions contain acidic substances, were free from sugars, and had relatively small amounts of amino-nitrogen. Microorganisms utilized all detected sugars as the only source of carbon in the medium, followed by formation of acids. (Jones-Wisconsin)

W70-03960

RX FOR AILING LAKES--A LOW PHOSPHATE DIET,
International Joint Commission-United States and Canada.
For primary bibliographic entry see Field 02H.
W70-03964

A DISCUSSION OF NATURAL AND ABNORMAL DIATOM COMMUNITIES,
Academy of Natural Sciences, Philadelphia, Pa. Dept. of Limnology.
Ruth Patrick.
Algae and Man, Jackson, Daniel F, (editor), Plenum Press, New York, p 185-204, 1964. 6 fig, 2 tab, 46 ref.

Descriptors: *Biological communities, *Diatoms, *Water pollution effects, Streams, Rivers, Environmental effects, Biomass, Bioindicators, Physiological ecology, Temperature, Salinity, Nutrients, Dystrophy, Acidic water, Humic acids, Chrysophyta, Oligotrophy, Eutrophication, Pennsylvania, Estuaries, Maryland, Hydrogen ion concentration, New Jersey, South Carolina, Industrial wastes, Texas.
Identifiers: *Community structure, Species composition, Eunotia, Savannah River, McMichael Creek (Pennsylvania), Middle River (Maryland), Ridley Creek (Pennsylvania), Egg Harbor River (New Jersey), Fragilaria, Achnanthes, Navicula, Nitschia, Synedra, Wateree River (SC), Gomphonema, Melosira, Cymbella, Neches River (Texas), Navicula, Bacillaria, Mesotrophy.

Diatom associations have been used variously as bioindicators of natural water quality conditions or of degree of disturbance due to pollution. Because we know little regarding physiological requirements and tolerance to pollution of particular species of diatoms, it is difficult to assess whether variations in species abundance and composition are due to normal environmental variation or to specific effects of pollutants. Changes in community structure, as indicated by changes of numbers of species or changes in percentage of composition of diatom communities attributable to dominant species, may be more reliable criteria of general pollutional conditions in flowing water. These principles are illustrated with data from a variety of streams and rivers of differing trophic or pollutional status. It can be shown, for example, that parameters of community structure for a dystrophic stream and for a badly polluted one are similar. In some cases, it is possible to find specific diatoms which are indicators of pollutional conditions duplicating natural conditions occurring during geological time. (See Vol 2, No 19, Field 5C, W69-07832). (Eichhorn-Wisconsin)
W70-03966

THE RESPONSE OF NATURAL MICROBIAL POPULATIONS IN SEAWATER TO ORGANIC ENRICHMENT,
Woods Hole Oceanographic Institution, Mass.
Ralph F. Vaccaro.
Limnology and Oceanography, Vol 14, No 5, p 726-735, Sept 1969. 6 fig, 10 ref.

Descriptors: *Water pollution effects, *Eutrophication, *Seawater, *Marine microorganisms, *Organic matter, *Microbial populations, Carbon radioisotopes, Kinetics, Atlantic Ocean, Amino acids, Carbohydrates, Organic acids, Aquatic populations, Massachusetts, Plankton, Estuaries, Microbiology, Physiological ecology.
Identifiers: *Enrichment, *Microbial populations, Heterotrophy, Heterotrophic potential technique, Michaelis-Menten equation, Lineweaver-Burk equation, Sargasso Sea, Glycine, Glucose, Phenylacetic acid, Malic acid, Woods Hole (Mass), Microplankton, Heterogeneous populations, Sodium lactate, Assimilation, Substrate affinity, Turnover times.

The heterotrophic potential technique (HTP) is based on kinetic behavior of enzymes, described by Michaelis-Menten equation. Aquatic microbial populations are incubated for short periods in presence of radiocarbon-labeled substrates (carbohydrates, amino and organic acids) and radiocarbon uptake determined. If plot of uptake velocity versus substrate concentration yields a hyperbolic curve, this can be converted to linear form (Lineweaver-Burk plot) whose intercept and reciprocal slope estimate, respectively, maximum time for complete removal of substrate, and maximum uptake rate. Applied to marine and other populations, uptake responses often fail to develop or resultant patterns are uninterpretable. When enrichment period is extended to 24 hours or more, such difficulties may be overcome. This shift in behavior provides a desirable source of cells for bioassays, and means for studying dynamics of heterotrophy. Trophic significance of organic matter in seawater might be studied by identification of specific compounds, but the complexity of this approach suggests that HTP might provide an effective alternative. Regional studies show no single kinetic pattern characterizing uptake by marine microplankton, and that heterotrophs are apparently inactive to some supposedly labile compounds, which phenomena may indicate a need for more rigid definition of 'availability' of organic compounds. (Eichhorn-Wisconsin)
W70-03967

BACTERIAL GROWTH RATE IN THE SEA: DIRECT ANALYSIS BY THYMIDINE AUTORADIOGRAPHY,
Indiana Univ., Indianapolis. Dept. of Microbiology.
Thomas D. Brock.
Science, Vol 155, No 3758, p 81-83, Jan 1967. 1 tab, 8 ref.

Descriptors: *Bacteria, *Growth rates, *Marine microorganisms, *Analytical techniques, Tritium, Rhodophyta, Connecticut, Rhode Island.
Identifiers: *Autoradiography, *Thymidine, Epiphytes, Leucothrix mucor, Pure cultures, Heterogeneous cultures, Antithamnion sarniense, Iceland, Long Island Sound (Conn), Microbial ecology, Non-parametric statistics, Narragansett Bay (RI), Cape Reykjanes (Iceland), Sudurnes (Iceland), Italy, Bay of Naples, Scotland, Loch Ewe (Scotland).

Estimating cellular growth rates with tritiated thymidine (TT) assumes that: desoxyribonucleic acid (DNA) is synthesized only by dividing cells; TT is incorporated into acid-insoluble cellular fraction only during DNA synthesis; cellular TT incorporation is detectable autoradiographically. TT incorporation rates in Leucothrix mucor, a marine filamentous epiphyte with recognizable morphology, was estimated in pure cultures by incubating with TT in seawater medium and preparing autoradiograms after different incubation periods. Radioactive cells were scored from autoradiograms. Comparison of incorporation rates with generation times yields relationship that 1% cells become radioactive after 0.002 generation. If following assumptions hold, that relationship can be used to estimate generation times in natural populations: relationship between TT uptake and generation time is constant within species; rate of TT uptake is linear and without lag; dilution of TT uptake is linear and without lag; dilution of TT with naturally occurring nonradioactive thymidine is negligible. Generation time (in minutes), so determined, for natural populations of Leucothrix from two sites were: Iceland 685, Long Island Sound 660. In combined pure culture with red alga, Antithamnion sarniense, in medium not normally supporting growth of Leucothrix alone, its generation time was 94. Described technique should be adaptable to organisms incorporating TT; available in pure culture; microscopically recognizable in nature. (Eichhorn-Wisconsin)
W70-03968

REPORT OF AN ALGAL BLOOM IN VIETNAM,
Hungarian Univ. of Agricultural Sciences, Godollo (Hungary). Inst. of Botany and Plant Physiology.
T. Hortobagyi.
Acta Biologica Academiae Scientiarum Hungaricae, Vol 20, No 1, p 23-34, 1969. 5 fig, 23 ref.

Descriptors: *Algae, Temperature, Cyanophyta, Chlorophyta, Scenedesmus, Benthos, Convection, Waves (Water), Fish, Sewage, Euglenophyta, Diatoms, Biological communities, Backwater, Ponds, Alaska.
Identifiers: *Bloom, *Vietnam, Little Lake (Hanoi), Red River (Vietnam), Chlorococcus, Spines, Schizomycophyta, Caulobacteriales, Chlorococcales, Conjugatophycaea, Planctomyces, Bacillariophyta, Gloecapsa, Merismopedia, Microcystis, Ankistrodesmus, Pediastrum, Tetraedron, Tetrastrum, Tisza (Hungary), Zimona (Hungary), Algal taxonomy, Spirulina, Chodatella, Miracantha, Buzsak (Hungary), Jamuna (India), Hormogonales, Aphanocapsa, Coelosphaerium, Chloronostoc, Pelodictyon, Synechocystis, Anabaena, Lyngbya, Oscillatoria, Romeria, Astasia, Schroederia, Coelastrum, Dictyosphaerium, Gloeoactinum, Golenkinia, Nephrochlamys, Nephrocytium, Oocystis, Siderocelis, Staurastrum.

An algal bloom of vivid green color developed in Little Lake, Hanoi (water temperature 13-26C). The lake, an isolated backwater of the Red River, contains contaminated water. The bloom was rich in species and new taxons with Cyanophyta and Chlorophyta from both surface and bottom dominating. Scenedesmus variability was prominent. A sample indicated 115 species without Bacillariophyceae. The number of the Scenedesmus species was larger than in the bloom. Cyanophyta dominated with 82% in the algal bloom and 92% in the bottom sample; Chlorophyta with 12% and 6.8%, respectively. No definite line of demarcation exists between the two biotopes because the algal bloom developed above the bottom and bottom plants are easily raised near the surface by waves, convectional streaming and fish movement. The algae of the two biotopes are different, the phytobiocoenoses being dissimilar. Number of common taxons is 51% of the total; undescribed taxons is 33%. Parallel morphoses are well represented by some Scenedesmus species. Among spiny forms of the Chlorococcales, those of thin spines are less frequent. Protuberances become more developed in Hanoi and toward the tropics. (Jones-Wisconsin)
W70-03969

STUDIES ON THE RESISTANCE OF MARINE BOTTOM INVERTEBRATES TO OXYGEN-DEFICIENCY AND HYDROGEN SULFIDE,
Kiel Univ. (West Germany). Institut fuer Meereskunde.
H. Theede, A. Ponat, K. Hiroki, and C. Schliefer.
Marine Biology, Vol 2, No 4, p 325-337, 1969. 6 fig, 5 tab, 67 ref.

Descriptors: *Invertegrates, *Oxygen requirements, *Gastropods, Temperature, Crustaceans, Oxygen, Hydrogen sulfide, Inhibitors, Benthic fauna, Oceans, Metabolism.
Identifiers: Lamellibranchs, Polychaetes, Echinoderms, North Sea, Baltic Sea, Kattegat, Cyprina, Scrobicularia, Mya, Nereis, Asterias, Ophiura, Carcinus, Gammarus, Idotea, Crangon, Mytilus, Cardium, Littorina littorea, Littorina saxatilis.

Resistance to oxygen deficiency and presence of hydrogen sulfide of bottom invertebrates from various biotopes of the North and Baltic Seas was investigated under laboratory conditions. Resistance of animals to adverse conditions was greater in species inhabiting soft bottoms than in those inhabiting hard or sandy substrata. The duration of ciliary movement was longer at lower temperatures. Excised tissues of boreal marine species also extended their activity for a longer period at a low temperature. Isolated gills of Mytilus edulis showed a higher resistance to sulfide ions and hydrogen sulfide at pH 7 than at pH 8. The cellular resistance of euryhaline species to oxygen deficiency and hydrogen sulfide presence declined very slightly with decreasing salinity. (Wilde-Wisconsin)
W70-03971

ALGAE, MAN, AND THE ENVIRONMENT.

Proceedings of an International Symposium held at Syracuse University, June 18-30, 1967. Daniel F Jackson, Editor. New York, Syracuse Univ Press, 1968. 554 p.

Descriptors: *Algae, *Environmental effects, *Human population, *Eutrophication, *Conferences, Nuisance algae, Publications, Water pollution effects, New York, Chlorophyta, Nutrients, Ecosystems, Phytoplankton, Photosynthesis, Cyanophyta, Cytological studies, Electron microscopy, Waste treatment, Lakes, Water quality, Viruses, Algicides, Fish, Streams, Productivity.
Identifiers: *Phycology, NY State Science and Technology Found, Syracuse (NY), Syracuse University, Fundamental studies, Applied studies, Algal physiology, Algal biochemistry, Algal taxonomy, Algal phylogeny, Cladophora, Algal genetics, Russia, Bavaria, Moriches Bay (NY), Onondaga Lake (NY).

Phycological studies are important not only because of nuisance effects of algae for man, but also for their potential benefits. To compile information on basic and applied phycology, a symposium--which this volume records--was sponsored by New York State Science and Technology Foundation and Syracuse University, New York (18-30 June 1967). Volume is organized into three sections: fundamental phycology, applied phycology, and algal studies in New York State. The following topical list of 27 papers by 32 contributors indicates its scope: historical phycology (1927-1967); taxonomy and phylogeny in algal biochemistry and physiology; algal requirements for micronutrients; phosphate metabolism of green algae; nitrogen input to aquatic ecosystems; light and temperature effects on algae; phytoplanktonic photosynthesis; photosynthesis of Cladophora; biology of filamentous conjugating algae; approach to modern algal taxonomy; trends in algal genetics; cytology of cyanophytes (blue-green algae); ultrastructure of cyanophytes; Russian experiments in algal culture; phycological medicine; Russian soil algology; harvesting waste-grown microalgae; wastewater treatment and algal growth; regeneration of Bavarian lakes; nutrient removal, viral diseases in cyanophytes; algicidal effects; algae-fish relationships; stream assimilation (New York); productivity, Moriches Bay (New York); algal environment, Onondaga Lake (New York); review of algal literature (New York State). An index is provided. (See W70-03974). (Eichhorn-Wisconsin)
W70-03973

ONONDAGA LAKE, NEW YORK--AN UNUSUAL ALGAL ENVIRONMENT,
Syracuse Univ., N. Y. Dept. of Civil Engineering.
Daniel F. Jackson.
Algae, Man, and the Environment, Syracuse Univ Press, New York, p 515-524, 1968.

Descriptors: *Algae, *Aquatic environments, *Eutrophication, *Meromixis, *Water pollution effects, Bioindicators, Nuisance algae, New York, Sewage effluents, Sewage treatment, Industrial wastes, Water chemistry, Diatoms, Chlorophyta, Euglenophyta, Cyanophyta, Chrysophyta, Bioassays, Saline water, Chlorella, Chlamydomonas, Euglena.
Identifiers: *Onondaga Lake (NY), Eunotia, Amphora, Gomphonema, Pinnularia, Nitzschia, Navicula, Syracuse (NY), Enteromorpha intestinalis, Cladophora, Cyclotella, Halochlorococcum, Synechococcus, Carteria, Gonium, Ankistrodesmus, Microspora, Pediastrum, Scenedesmus, Lepocinclis, Anabaena, Anacystis, Gloeotrichia, Gloeocapsa, Stauroneis.

Fed by saline springs, Lake Onondaga has highest known chloride content (typically 1460 milligrams/liter) of New York lakes and is probably meromictic. Its morphometric, geographic and historical features are described, and water quality data are tabulated to include comparisons with other lakes. Although subject to extensive eutrophication since 1863, it fails to bloom with planktonic cyanophytes, but annual blooms of chlorophytes and euglenophytes have occurred during summers since 1962. Lake receives industrial pollutants. Two characteristic areas are observable, based on distribution of attached algae, Cladophora and Enteremorpha; variations in the ionic ratio, sodium/calcium, are thought to control their distribution. Lake supports abundant growth of diatoms, distributed among 28 genera. In a study to evaluate effects on the lake of replacing primary treatment plants with improved secondary treatment, growth of ten strains of chlorophytes, two euglenophytes, eight diatoms, and five cyanophytes cultured in four concentrations of enriched lake water was compared with their growth in nutrient media. Bioassay data are tabulated; summarized, they indicate that lake's water will not support growth of planktonic cyanophytes, and that some component stimulates growth of diatom, Cyclotella, and the chlorophytes: Chlamydomonas, Halochlorococcus, and Chlorella (Milford strain). (See also W70-03973). (Eichhorn-Wisconsin)
W70-03974

EUTROPHICATION: CAUSES, CONSEQUENCES, CORRECTIVES.
National Academy of Sciences, Washington, D.C.

Proceedings of symposium held June 11-15, 1967, Wisconsin Univ, Madison. Gerard A Rohlich, Chairman, Planning Committee for the International Symposium on Eutrophication. NAS Standard Book No 309-01700-9. Printing and Publishing Office, National Academy of Sciences, Washington, DC, 1969. 661 p.

Descriptors: *Eutrophication, *Water pollution sources, *Water pollution effects, *Water pollution control, *Conferences, Streams, Estuaries, Lakes, Great Lakes, Physiological ecology, Water chemistry, Geographical regions, Cycling nutrients, Zooplankton, Algae, Aquatic plants, Paleolimnology, Mathematical models, Bacteria, Phytoplankton, Geochemistry, Benthos, Fish, Ecosystems.
Identifiers: National Academy of Sciences (USA), University of Wisconsin, Asia, National Research Council (USA), US Atomic Energy Commission, National Science Foundation, Office of Naval Research, US Department of Interior, Madison (Wis), Europe, Water pollution assessment, Urban drainage, Agricultural drainage, North America, Forest drainage.

In 1965, a planning committee appointed by National Academy of Sciences-National Research Council (NAS-NRC) recommended that '--an international symposium on eutrophication be held in order that the present worldwide state of knowledge and understanding of this phenomenon can be discussed in open forum and recommendations developed for the effective management of problems and for the course of future research.' That symposium met at University of Wisconsin, Madison, 11-15 June 1967, sponsored by NAS-NRC, Atomic Energy Commission, Department of Interior, National Science Foundation, and Office of Naval Research. Approximately 600 persons from 12 countries attended. This report of proceedings includes an introductory address, 'Eutrophication, Past and Present', by Yale University Professor G. E. Hutchinson, and four sections of technical presentations as follows (numbers of contributions to each indicated in parentheses): geographical concepts (9); detection and measurement (7); prevention and correction (8); scientific contributions from eutrophication research (8). Two papers, presented at conference, are not published here. The report also includes an introduction, summary, and series of specific recommendations formulated by the organizing committee: 12 relating to education and information and 8 to research. The committee also recommended that NAS-NRC form a permanent committee to implement its recommendations. (See also W70-03976 and W70-03977). (Eichhorn-Wisconsin)
W70-03975

SOME POSSIBLE PHYSIOLOGICAL STRESSES INDUCED BY EUTROPHICATION,
Toronto Univ. (Ontario).
F. E. J. Fry.
Eutrophication: Causes, Consequences, Correctives. Proceedings of a Symposium, National Academy of Sciences, Washington, DC, p531-536, 1969. 4 fig, 13 ref.

Descriptors: *Eutrophication, *Physiological ecology, Water pollution effects, Dissolved oxygen, Fish, Lakes, Hypolimnion, Brook trout, Carbon dioxide, Rainbow trout, Anaerobic conditions, Toxicity, Respiration, Temperature, Environmental effects, Phytoplankton, Metabolism, Bass, Cisco.
Identifiers: *Physiological stresses, Phototrophic zone, Carassius carassius, Rasbora daniconius, Oxykinetic responses, Coregonus artedi, Lake Nipissing (Ontario), Ontario, Canada, Osmoregulation, Micropterus salmoides, Algal blooms, Mechanical effects, Salvelinus fontinalis.

Physiological stresses on organisms induced by eutrophication are little understood. Oxygen reduction in eutrophic waters is probably the most pressing stress on fishes. Two types of fluctuations take place: long-term, occurring in hypolimnetic waters and under ice-cover; and short-term, in phototrophic zones due to variations in illumination. Interactions of carbon dioxide, temperature, and ambient oxygen in influencing physiology of a highly aerobic fish are illustrated with data for brook trout. Rainbow trout respond to lowered ambient dissolved oxygen with increased locomotory activity and increased ventilation, responses which may expose fish to futher stresses. Oxykinetic responses of fishes may move them to regions where dother conditions are unfavorable, and increased ventilation tends to increase uptake of toxic substance via gills. Increased irrigation of gills tends also to increase metabolic cost of osmoregulation, which may amount to about 20% of metabolic rate of rainbow trout in hard waters. Under eutrophic conditions, where oxygen concentrations vary widely during a day, fish are probably not as unstressed as the mean concentration may suggest, even though daily minimum is above lethal level. (See also W70-03975). (Eichhorn-Wisconsin)
W70-03976

PHYSIOLOGICAL ECOLOGY,
Oregon State Univ., Corvallis. Dept. of Botany.
Harry K. Phinney.
Proceedings of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ, Berkeley, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Ore, Pac Northwest Water Lab, p 141-145. 1 fig, 5 ref.

Descriptors: *Physiological ecology, *Aquatic environments, Rivers, Environmental effects, Periphyton, Water pollution effects, Oregon, Bioindicators, Light intensity, Eutrophication, Grazing, Algae, Water chemistry, Biomass, Benthos, Salinity, Snails, Sulfates, Nitrates, Phosphates, Potassium, Iron, Bicarbonate, Zinc, Cobalt, Calcium, Magnesium, Currents (Water).
Identifiers: Berry Creek (Ore), Oregon State University, Experimental streams, Seasonal effects, Thermal effects, Aphanizomenon flos aquae, Metolius River (Ore), Community structure, Oxytrema, Organic enrichment, Interactions.

Physiological ecology may be defined as the study of physiological responses of organisms to variations in ecological conditions experienced in nature or to those which can be manipulated in the laboratory. Both laboratory and field approaches to ecology suffer from basic philosophical and methodological defects. Physiological ecologists attempt to retain a balanced perspective, and maintain an awareness of these pitfalls in interpreting data and constructing generalizations. Specific studies are cited which illustrate these principles for a variety of aquatic environments (rivers, laboratory

streams, and estuaries) and for a variety of influencing factors (chemical, physical, and biotic). Because of complexities in elucidating causal factors influencing species abundance, great caution should be exerted in identifying algal species as indicators of pollution. Accumulation of information relative to physiological ecology is slow, laborious, and fraught with difficulties hampering correct interpretation. It is unlikely that 'crash' programs designed to characterize the physiological ecology of cultural eutrophication can provide solutions to our present crisis in time to prevent the foreseeable disaster. (See Vol 3, No 7, Field 5C, entry W70-02775). (Eichhorn-Wisconsin)
W70-03978

PRODUCTIVITY OF RIVERS,
Montana State Univ., Bozeman. Center for Environmental Studies.
John C. Wright.
Proceedings of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ, Berkeley, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Ore. Pac Northwest Water Lab, p 186-206. 8 fig, 6 tab, 24 ref.

Descriptors: *Productivity, *Rivers, Carbon dioxide, Photosynthesis, Aquatic plants, Alkalinity, Bicarbonates, Nitrogen cycle, Ammonia, Organic matter, Bacteria, Nutrients, Phosphates, Nitrates, Groundwater, Respiration, Sampling, Wyoming, Thermal water, Chemical analysis, Insects, Productivity, Diurnal, Standing crop, Light intensity, Plant growth, Solar radiation, Chara.
Identifiers: Firehole River (Wyo), Madison River (Wyo), Gibbon River (Wyo), Trichoptera, Ephemeroptera, Nez Perce Creek (Wyo), Carbon/nitrogen ratio, Diversity indices, Myriophyllum, Glyceria, Ranunculus, Fontinalis, Potamogeton, Nitella, Ruppia, Utricularia, Zannichellia, Carex, Hippuris, Scapania, Berula, Eleocharis, Junus, Rorippa, Hygrophypnum, Fissidens.

Enrichment of rivers by organic pollution with photosynthetically available carbon dioxide may be equally important as fertilization with other nutrients. Based on field studies, the conclusion is that maximal photosythetic rates are attained only in flowing water of high total alkalinity. Percentage of stream bottom covered by vegetation and diversity of communities multiply with total alkalinity increases. Regardless whether free carbon dioxide or bicarbonate were used as a carbon source, the rate of photosynthesis decreased when initial pH values above 8.0 occurred; presumably this si due to limitation of photosynthesis by decreasing concentrations of free carbon dioxide. Evidence is also presented suggesting that various species of aquatic macrophytes differ in their ability to utilize bicarbonate ion in contrast to free carbon dioxide. Also determined is that, on the average, 20% of photosynthetically-fixed carbon appears in soluble organic form; the nitrogen cycle appears involved, since soluble organic substances become more enriched with nitrogen during photsynthesis and a rise in ammonia concentrations also accurs during the photosynthetic period. Soluble organic compound, released during photosynthesis, may be important as food substrate for bacteria in flowing-water ecosystems. (See Vol 13, No 7, Field 5C, entry W70-02775). (Jones-Wisconsin)
W70-03979

C-14 UPTAKE AS A SENSITIVE MEASURE OF THE GROWTH OF ALGAL CULTURES,
California Univ., Davis. Dept. of Zoology; and California Univ., Davis. Inst. of Ecology.
Charles R. Goldman, Milton G. Tunzi, and Richard Armstrong.
Proceedings of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ, Berkeley, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Ore, Pac Northwest Water Lab, p 158-170. 6 fig, 1 tab, 11 ref.

Descriptors: *Carbon radioisotopes, *Algae, *Cultures, Phytoplankton, Carbon, Radioactivity, Chlorella, Sampling, Effluents, Tributaries, Alkalinity, Hydrogen ion concentration, Nutrients, Phosphorus, Nitrogen, Iron, Growth rates, Chlorophyta, Cyanophyta, Chrysophyta, Photosynthesis.
Identifiers: *Growth, *Uptake, Fixation, Cell count, Optical density, Particulate organic carbon, Lake Tahoe (Calif), Chlorella pyrenoidosa, Selenastrum gracile, Carbon assimilation, Bacillariophyceae, Dinophyceae.

Results of comparisons to determine reliability of carbon-14 experiments with other methods employed for measuring growth in cultures are summarized. These include making cell counts, measuring the increase in light extinction as the cells multiply, and determining the biomass of cells produced. Results of a Chlorella experiment provide a valuable evaluation of these methods. The cell count was quite successful; the optical density method was fastest and easiest but was mainly applicable to measuring concentration of dense cultures. The carbon-14 method can easily be used for measuring algal cell growth in both nutrient-rich and nutrient-poor waters. Carbon-14 can detect growth in water with natural phytoplankton when cell count and optical density methods do not give evidence of any change in algal mass; carbon-14 data give a carbon fixation rate, whereas cell count and optical density measurements are static measures of mass. In addition, carbon-14 experiments yield values proportional to the mass of cells in a culture. The combined effect of nitrogen and phosphorus was to stimulate photosynthesis, the greatest stimulation resulting from the maximal addition of the two nutrients. (See Vol 3, No 7, Field 5C, entry W70-02775). (Jones-Wisconsin)
W70-03983

5D. Waste Treatment Processes

EVAPORATIVE COOLING OF HEATED IRRIGATION WATER BY SPRINKLER APPLICATION,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.
J. N. Cline, M. A. Wolf, and F. P. Hungate.
Water Resources Research, Vol 5, No 2, p 401-406, Apr 1969. 1 fig, 3 tab, 20 ref.

Descriptors: *Heated water, *Sprinkler irrigation, Temperature control, Cooling, Irrigation, Evaporation, Crop production.
Identifiers: *Impact temperature, Relative humidity, Nozzle pressure, Evaporative cooling.

Heated water was cooled rapidly to impact temperatures that produce optimum growth in plants by applying the water with a standard irrigation sprinkler. Maximum cooling was observed nearest the sprinkler, where the smallest droplets were measured, and temperatures and mean diameters generally increased with distance from the source. Impact temperatures of the water droplets approached but did not reach wet bulb temperatures. Water as hot as 50 deg C was cooled to droplet temperatures of 25 deg C or less when the sprinklers were operated in an associated arid climate and at line pressures greater than 25 psi. A theoretical treatment correlated well with one selected set of experimental data and with predicted cooling rates for specified droplets in several typical atmospheric conditions and one untypical condition for an arid climate. Only under the condition of high relative humidity at a given ambient temperature does it appear that cooling might be insufficient to produce usable sprinkler water from 50 deg C supply water for crop production. (Rietveld-Vanderbilt)
W70-03718

TEMPERATURE RELATIONSHIP IN AEROBIC TREATMENT AND DISPOSAL OF PULP AND PAPER WASTES,
National Council for Stream Improvement, Baltimore, Md.
William L. Carpenter, James G. Vamvakias, and Isaiah Gellman.
Journal Water Pollution Federation, No 40, p 733-740, May 1968. 3 fig, 6 tab, 12 ref.

Descriptors: *Temperature, *Lagoons, *Activated sludge, *Biochemical Oxygen Demand, Industrial wastes, Pulp and Paper Industry, Pulp wastes.
Identifiers: *Aerated Lagoons, Temperature coefficients, Deoxygenation rate, Temperature effect.

Tabulated and graphical results are given of studies on the effect of temperature on the performance of aerated lagoons and activated-sludge plants treating waste waters from pulp and paper mills and on the rate of de-oxygenation of such waste waters in streams. It was found that BOD removal in aerated lagoons is adversely affected by temperatures below 20 deg C, but this effect can be minimized by increasing the retention period to 10 days, when BOD removals of 79 per cent can be obtained at temperatures as low as 2 deg C. For activated-sludge treatment the optimal temperature was found to be 37 deg C, and there was a progressive deterioration in performance as the temperature was raised to 52 deg C. The de-oxygenation rate constant was the same for both crude and treated waste waters, and equalled 0.2 at 20 deg C. The temperature coefficients for de-oxygenation rate and rates of removal of BOD were estimated. (Rietveld-Vanderbilt)
W70-03720

COOLING WATER SOURCES FOR POWER GENERATION,
Westinghouse Electric Corp., East Pittsburgh, Pa.
L. G. Hauser.
ASCE National Water Resources Meeting, Memphis, Tennessee, Jan 26-30, 1970. 22 p, 9 fig, 7 tab.

Descriptors: *Cooling, *Thermal pollution, *Cooling towers, Thermal powerplants, Environmental engineering, Heat balance, Heated water, Optimization, Nuclear powerplants, Electricity, Electric power production, Electric power costs, Electric power demand, Economic prediction, Costs, Economics, Decision making, Project planning.

The forecast of future electricity production in the U.S.A. is projected; and the possibilities of cooling of the future released heat are discussed. The forecast is made up to the year 2000 and shows that residual heat dissipation will be a serious problem for future generating plants. The further main conclusions are: (1) The cost of alternate heat dissipation methods is not prohibitive and will not deter the growth in demand for electric power. (2) Approximately 70% of new base load generating stations will require supplemental cooling systems by 1980. (3) Cost penalties of supplemental cooling systems can be minimized with sophisticated analytical techniques. Optimization techniques for overall least cost of power production and cooling are illustrated. (Novotny-Vanderbilt)
W70-03727

COMPARISON STUDIES OF WINKLER VS. OXYGEN SENSOR,
Decatur Sanitary District, Ill.
For primary bibliographic entry see Field 05A.
W70-03876

MANAGEMENT OF INDUSTRIAL EFFLUENT DISPOSAL IN BRITAIN,
Distillers Co. Ltd., London (England). Dept. of Effluent and By-Products.
C. J. Jackson.
Journal Water Pollution Control Federation, Vol 41, No 12, p 2018-2025, Dec 1969. 8 p, 2 fig.

Descriptors: *Water management (Applied), *Waste disposal, *Industrial wastes, Water conservation, Waste treatment, Waste water treatment, Management, Water law.
Identifiers: *Great Britain, Waste disposal management.

The relationships between governmental agencies and industrial plants in Britain are outlined. Industrial management investigates all aspects of effluent disposal, taking into consideration the economics of internal treatment or discharge to a public wastewater collection system. Pretreatment prior to discharge to the public system is an important consideration of management. Choice of method involves a comprehensive study of treatment processes. Pilot studies should be made on site. Testing services are available through the government on a repayment basis. Consulting arrangements also may be made with private firms. Control agencies sample outfalls and may initiate legal action against industrial plants with notification and submission of duplicate samples to the plant. Committees of the Confederation of British Industry and the Chemical Industries Association advise industrial operations and act as liaisons between industry and government. The range of treatment and capital costs for pollution abatement facilities is reported. (Knapp-USGS)
W70-03877

TUBE CLARIFICATION PROCESS, OPERATING EXPERIENCES,
Neptune Microfloc, Inc., Corvallis, Oreg.
Gordon L. Culp, Kou-ying Hsiung, and Walter R. Conley.
J San Eng Div, Amer Soc Civ Eng, Vol 95, No SA5, Proc Paper 6823, p 829-847, Oct 1969. 11 fig, 2 tab, 12 ref.

Descriptors: *Operations, *Sedimentation, *Sediments, *Design, Costs, Waste water, Tertiary treatment, Filtration, Water treatment, Sewage treatment, Construction, Filtration.
Identifiers: *Clarification, *Shallow-depth-sedimentation, *Tube-clarifier system, Primary treatment, Secondary treatment, Raw water treatment, Pilot tests.

The use of small diameter tubes as efficient sedimentation devices has been demonstrated successfully on a plant scale. Shallow settling depths provided by longitudinal flows through tubes results in more efficient clarification at shorter detention times and less cost than for conventional clarification metods. Tubes may be essentially horizontal such that tube clarification is followed by a filtration process and settled solids in tubes drained incident to filter backwasher. By steeply inclining the tubes, settled solids do not accumulate in tubes but slide into the plenum beneath the tubes, precluding tube drainage. Modules of steeply inclined tubes have increased the capacity of clarifiers from 2 to 4 times. Steeply-inclined tube process has been applied to raw water clarification, primary, secondary and tertiary sewage treatment in plants up to 45 mgd capacity. The size and cost of new clarifiers can be reduced by including the tube concept in the original design and construction. (D'Arezzo-Texas)
W70-03911

RELATIVE TOXICITIES AND DISPERSING EVALUATIONS OF ELEVEN OIL DISPERSING PRODUCTS,
Washington State Water Pollution Control Commission, Olympia. Dept. of Fisheries.
For primary bibliographic entry see Field 05C.
W70-03913

GRAVITY THICKENERS FOR ACTIVATED SLUDGE,
Alexander Potter Associates, New York.
Anton E. Sparr, and Vincent Grippi.
Journal Water Pollution Control Federation, Vol 41, No 11, Part 1, p 1886-1904, Nov 1969. 12 fig, 1 tab, 26 ref.

Descriptors: *Activated sludge, *Coagulation, *Compaction, Sludge, Disinfection, Equipment, Solid wastes, Temerature, Wastewater.
Identifiers: *Sludge density index, *Sludge volume index, *Thickening, *Sludge-volume ratio, *Bench-scale study, Coring, pH, pilot-plant study.

This study investigates the use of gravity thickening of excess sludge from complete treatment activated sludge processes. Factors affecting the concentration in separate thickening tanks of activated sludge alone, or combined with primary sedimentation solids, are discussed. A bench-scale study and historical review are sources of basic data for the investigation. Major subdivisions of the study include: tank geometry, types of thickener, mechanical equipment, influent baffling, skimmers, mechanical compactors, sludge pumps, solids concentration, temperature, loading, pH, coagulation, disinfectants and weighting agents. Mechanical deflectors and rake arms are suggested for more efficient thickening. (D'Arezzo-Texas)
W70-03914

TEMPERATURE EFFECTS ON ENERGY OXYGEN REQUIREMENTS IN BIOLOGICAL OXIDATION,
Weston (Roy F.), Inc., West Chester, Pa.
C. S. Shih, and V. T. Stack, Jr.
Journal Water Pollution Control Federation, Vol 41, No 11, p R461-R474, Nov 1969. 7 fig, 9 tab, 17 ref.

Descriptors: *Oxidation, *Oxygen demand, *Synthesis, *Temperature, Activated sludge, Respiration, Dissolved oxygen, Aerobic conditions, Degradation.
Identifiers: *Energy oxygen, *Dehydrogenase, *Enzyme activity, Organic substrates, Warburg study, Energy oxygen coefficient, Glucose, Sodium acetate, Ethylene glycol, Potassium hydrogen phthalate, DO Uptake, Short term oxygen demand, Tube-run.

Temperature effects on energy oxygen requirements are considered a key quantitative parameter in the aerobic biological oxidation phase of waste treatment. Energy oxygen is the net consumption of oxygen in support of synthesis reactions. The energy oxygen coefficient is the total energy oxygen consumption less endogenous oxygen divided by organic substrate material. Biological oxidation studies were made for various organic substrates at different temperature conditions. Two different evaluation methods were used: (1) graphical integration of dissolved oxygen uptake versus time; (2) short term oxygen demand. The coefficient varies with the substrates oxidized and temperature. The role of dehyrogenase activity analysis in biological oxidation is also examined. (D'Arezzo-Texas)
W70-03919

FERMENTATION OF SPENT SULFITE LIQUOR FOR THE PRODUCTION OF VOLATILE ACIDS,
Crown Zellerbach Corp., Camas, Wash. Microbiological Research.
H. R. Amberg, T. R. Aspitarte, and J. F. Cormack.
Journal Water Pollution Control Federation, Vol 41, No 11, Part 2, p R419-R430, Nov 1969. 4 fig, 9 tab, 18 ref.

Descriptors: *Fermentation, *Volatility, *Acids, *Solvent extractions, Distillation, Productivity.
Identifiers: *Acetic acid, *Calcium base liquors, *Microbacterial action, Spent sulfite, Liquors, Volatile acids, Microbial flora, Othmer azeotropic, Distillation process, Suida process, Brewster process.

Study and experiments were made to determine if volatile acids, specifically acetic acid, could be produced by fermentation of sugars in spent sulfite liquor. Substrates used for experiments were: (1) steam-stripped digester strength calcium base spent sulfite liquor; (2) residual alcohol-fermented spent sulfite liquor. Fermentations were made successfully on a continuous-flow basis using mixed bacterial culture. Specific major determinations were: (1) Optimum volatile acid yields were obtained amounting to 155 Kg per metric ton at volumetric waste retention periods of 20 to 30 hours, (2) optimum fermentation temperature was 37 deg C and optimum pH range was 7.0 to 7.5; (3) solids content of the raw feed liquor had a decided effect of yield; (4) optimum yield was obtained at 9 to 11 percent total solids; (5) the most economical method of acetic acid recovery is solvent extraction followed by azeotropic distillation for solvent recovery. (D'Arezzo-Texas)
W70-03921

A BREAKTHROUGH IN THE TRACER STUDIES OF SEDIMENTATION TANKS,
Nova Scotia Technical Coll., Halifax. Dept. of Civil Engineering.
D. Thirumurthi.
J Water Pollution Control Federation, Vol 41, No 11, Part 2, p R405-R418, Nov 1969. 9 fig, 5 tab, 22 ref.

Descriptors: *Tracers, *Dispersion, *Sedimentation, *Costs, *Design, Baffles, Inlets, Outlets, Diatomaceous earth, Diffusivity, Dye releases, Fluorometry, Suspension, Settling basins, Reynolds number.
Identifiers: *Pulse input technique, *Plug flow, *Detention time, *Flow-through curve, Tracer studies, Index of short-curcuiting, Critical settling depth, Peclet number, Morril index, Dispersion index, Continuous-flow systems, Settling index.

Increasing costs of waste treatment compel design-oriented research with view toward reducing treatment costs. Sedimentation is considered a vital phase justifying closer analysis. Tracer studies and sedimentation tests were conducted on two continuous-flow laboratory model settling tanks of similar geometry except length-width ratios. Tracer studies of pulse input technique were made to demonstrate that two selected parameters were reproducible and useful as design criteria for sedimentation systems. The study is unique in the fact that results of tracer tests have been inter-related with results of sedimentation tests on the continuous-flow models. The deviation of real systems from the ideality has been considered. A design formula for actual sedimentation tanks has been suggested. Further studies or simulations are needed to validate the suggested design formula. A method is developed to evaluate the relative advantages of geometric design features of sedimentation tanks. (D'Arezzo-Texas)
W70-03922

A METHOD FOR PREDICTING THE EFFECTS OF LIGHT INTENSITY ON ALGAL GROWTH AND PHOSPHOROUS ASSIMILATION,
Abbott Labs., North Chicago, Ill. Dept. of Sanitary Engineering; and Michigan Univ., Ann Arbor.
For primary bibliographic entry see Field 05C.
W70-03923

DIPLOGASTERID AND RHABDITID NEMATODES IN A WASTEWATER TREATMENT PLANT,
Louisiana Polytechnic Inst., Ruston. Dept. of Zoology; and Southfield School, Shreveport, La.
J. L. Murad, and G. T. Bazer.
Journal Water Pollution Control Federation, Vol 42, No 1, p 106-114, Jan 1970. 4 fig, 4 tab, 11 ref.

Descriptors: *Aerobic treatment, *Wastewater, *Trickling filters, *Effluents, Wastewater treatment, Settling basins.
Identifiers: *Nematode, *Secondary clarifiers, *Primary clarifier, *Diplogasterid, *Rhabditid, Christie-Perry technique, Ruston (La).

Nematode population samples from various, likely breeding sites in aerobic waste treatment process at wastewater treatment plant, Ruston, Louisiana were analyzed for 15 weeks. The main breeding site, and the main source of the nematodes found in the final effluent was the trickling filter. Secondary clarifiers and final settling tanks effectively removed the nematodes. Nematode removal was highest in the dilution stream under high flow conditions than during normal stream flow. Solids in the effluent were more efficient in removing ne-

matodes in suspension. Settling without the addition of stream bottom solids provided a 17.1% removal whereas the addition of solids caused a 32.2% removal. (D'Arezzo-Texas)
W70-03925

BIODEGRADABILITY AND TREATABILITY OF COMBINED NYLON AND MUNICIPAL WASTES,
Rhode Island Univ., Kingston. Dept. of Civil Engineering.
C. P. C. Poon.
Journal Water Pollution Control Federation, Vol 42, No 1, p 100-105, Jan 1970. 1 fig, 8 tab, 2 ref.

Descriptors: *Biodegradation, *Industrial wastes, *Treatment, *Wastewater treatment, *Waste disposal, Degradation, Biochemical oxygen demand, Chemical oxygen demand, Aeration, Activated sludge.
Identifiers: *Nylon, *Nylon waste, *Municipal wastes, pH, Warburg respirometer, Belding Chemical Co. (Conn), Thomaston (Conn).

Nylon waste contains high organic content, large amount of solvents and low pH. The solvents can be recovered economically; therefore, it is advisable to separate the nylon production process waste from the others for recovery purposes. The other wastes can be combined and treated successfully with municipal wastewater. The amount of nylon wastewater which can be accepted by the municipal plant can be determined by specified laboratory studies. It was shown that nylon waste from the Belding Chemical Co. could combine successfully with municipal wastewater at the Thomaston Plant at a rate of 1:7 for successful treatment after pH neutralization. Laboratory study involved Warburg respirometer and batch feed aerator. The average chemical oxygen demand removal was 88% at a loading of 0.85 lb COD/day/lb of MLVSS. (D'Arezzo-Texas)
W70-03926

PHYSICOCHEMICAL TREATMENT OF WASTEWATER,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering; and FMC Corp., Princeton, N.J.
W. J. Weber, C. B. Hopkins, and R. Bloom, Jr.
Journal Water Pollution Control Federation, Vol 42, p 83-99, Jan 1970. 10 fig, 1 tab, 14 ref.

Descriptors: *Water reuse, *Waste treatment, *Activated carbon, *Adsorption, *Biochemical oxygen demand, *Sewage treatment, Costs, Nitrates, Phosphates, Tertiary treatment.
Identifiers: *Advanced waste treatment, *Chemical removal, *Physicochemical treatment, Secondary treatment, Total organic carbon, Ewing-Lawrence Sewerage Authority (ELSA), Trenton (New Jersey).

Conventional 'secondary' biological waste treatment processes are inadequate to provide the effluent quality needed for water reuse purposes or to provide a satisfactory degree of pollution protection to receiving natural water bodies, based on anticipated, more stringent future demands. A process using chemical clarification, filtration, and adsorption by activated carbon for treatment of primary wastes was designed and tested on a pilot-scale basis. This physicochemical treatment process is a major departure from the costlier practice of tertiary treatment methods following conventional secondary treatment. The system was designed for essentially automatic operations. The physicochemical pilot model phase was operated continuously for 4 months. Consistent total organic carbon and biochemical oxygen demand removals of 95-97%, phosphate removals of 90% and nitrate removals of 95% were obtained. Costs are about $0.16/1,000 gal, including capital amortization. Process affords flexibilities to expand on a modular basis and to intensify degree of treatment. (D-'Arezzo-Texas)
W70-03927

ANIONIC AND NONIONIC SURFACTANT SORPTION AND DEGRADATION BY ALGAE CULTURES,
Texas Univ., Austin. Dept. Environmental Health Engineering.
Ernst M. Davis, and Earnest F. Gloyna.
Journal of the American Oil Chemists' Society, Vol 46, No 11, p 604-608, Nov 1969. 2 fig, 3 tab, 9 ref.

Descriptors: *Surfactants, *Sorption, *Algae, Chlorophyta, Cyanophyta, Detergents, Spectroscopy.
Identifiers: *Linear alkyl sulfonates, *Axenic cultures, *Alkyl polyethoxylate, *Alkyl phenol polyethoxylate, Organic extractions, Infrared spectroscopy, Blue-green algae, Green algae.

Investigation was made to determine effects of axenic cultures of 5 species of Cyanophyta algae and 3 species of Chlorophyta algae, which are common to waste stabilization ponds, on ionic and anionic surfactants contained in the bulk of household detergent products. Tests made to determine the sorption characteristics of the surfactants by the algae showed releases and degradation of up to 99% of some of the component parts of the surfactant molecule. Comparative tests using a heterogeneous microcosm associated with laboratory acclimated stabilization pond water showed capability of greater reduction of all surfactant components than the individual algae species. The tests confirmed the feasibility of using infrared spectrophotometric analysis techniques and the adequacy of organic solvents for extraction of surfactants prior to complexation in concentrations of and below 50 mg/l. (D'Arezzo-Texas)
W70-03928

DIALYSIS SEPARATION OF SEWAGE SLUDGE DIGESTION,
Nebraska Univ., Lincoln. Dept. of Civil Engineering.
M. J. Hammer, and J. A. Borchardt.
J Sanit Eng Div, Proc Amer Soc Civ Eng, Vol 95, No SA5, Paper 6845, p 907-928, Oct 1969. 17 fig, 9 tab, 5 ref.

Descriptors: *Dialysis, *Fermentation, *Sewage sludge, Sewage treatment, Digestion, Digestion tank, Microbiology, Microorganisms.
Identifiers: *Anaerobic, *Acidification, *Gasification, *Dialysis fermentation tank, Diffusion, pH, Electrode potential, Membrane, Vinyl plastic, Alkalinity, Volatile acid, Digestion gases, Hydrolysis methane.

The acidification and gasification stages of high-rate anaerobic digestion are studied separately, using a dialysis-fermentation tank apparatus unique to sanitary engineering research. Raw sludge fed into the tank provided substrate for bacterial production of volatile acids. The acids were then diffused through the plastic membrane in the dialysis unit, into the methane fermentation tank for conversion to gaseous end products. The process of sludge digestion can be performed using a dialysis-fermentation tank system. This system permits pseudo-enrichment culturing of the anaerobic sludge digestion stages (acidification and gasification) to take place in separate fermentation tanks. The acidification stage is the rate-limiting process. The acid fermenters operate at sub-optimum conditions to permit optimum conditions needed for methane fermentation of the volatile acids. (D-'Arezzo-Texas)
W70-03929

PHOSPHATE REMOVAL AT BALTIMORE, MARYLAND,
Robert S. Kerr Water Research Center, Ada, Okla.
M. R. Scalf, F. M. Pfeffer, L. D. Lively, J. L. Witherow, and C. P. Priesing.
J Sanit Eng Div, Proc Amer Soc Civ Eng, Vol 95, No SA5, Paper 6817, p 817-827, Oct 1969. 6 fig, 1 tab, 4 ref.

Descriptors: *Activated sludge, *Aeration, *Phosphates, Phosphorous, Sewage treatment, Municipal wastes.
Identifiers: *Pilot investigation, *Plant investigation, *Activated sludge treatment, Dye tracer, Biochemical oxygen demand, Mixed liquor suspended solids, Baltimore (Md), San Antonio (Tex).

Pilot and plant investigations were conducted at Baltimore to determine if high orthophosphate removal process experienced at San antonio, Texas was applicable and feasible in Baltimore, differing in climate, population served and population characteristics. Phosphate removal by activated sludge at Baltimore was a function of mixed liquor dissolved oxygen concentration, BOD loading, and soluble phosphorous loading. Plant research showed in excess of 90% soluble phosphorous removal coinciding with plug flow conditions in the aeration tanks and high dissolved oxygen concentrations in the mixed liquor and final clarifiers. Pilot studies using aerated containers of mixed liquor containing plant return sludge and primary effluent predicted the reaction of the plant activated sludge process. A minimum mixed liquor suspended solids concentration of 1200 mg/l is needed for over 99% phosphate removal at Baltimore. Using mixed liquor suspended solids concentration similar to plant conditions showed: (1) Increased orthophosphate load needed longer aeration for phosphate removal; (2) Increased BOD caused greater initial phosphate concentrations; (3) Increased aeration rates decreased the phosphate removal time. The investigation showed that phosphate removal by the activated sludge process is not unique to the San Antonio, Texas area. (D'Arezzo-Texas)
W70-03930

TRICKLING FILTER MODEL: DESIGN AND COST FACTORS,
Robert A. Taft Water Research Center, Cincinnati, Ohio.
Joseph F. Roesler, and Robert Smith.
Industrial Water Engineering, Vol 6, No 9, p 46-49, Sept 1969. 8 fig, 6 ref.

Descriptors: *Trickling filters, *Mathematical models, *Design, *Cost allocation, *Biochemical oxygen demand, Waste water treatment, Efficiencies, Capital costs, Operation and maintenance, Computers.

A mathematical model of a trickling filter final settling process was described in the study. The model constituted a single subroutine in a computer program involving the preliminary design of wastewater treatment systems. The subroutine specifically computed the relationship of the various physical properties of the trickling filter, BOD removal efficiencies, and costs. The latter included capital, operating and maintenance costs for the trickling filter, final settler and return pumps. The costs to remove BOD was plotted against the hydraulic loading. For filter depths of 6 and 20 feet, minimum costs were observed near hydraulic loadings of 10 and 20 mgd per acre, respectively. Plots of total costs rather than costs per BOD removed indicated that the greater the specific area, the lower the costs. (Thiuri-Cornell)
W70-03947

RECLAIMED WASTEWATER FOR SANTEE RECREATIONAL LAKES,
Public Health Service, San Diego, Calif. Santee Recreation Project.
John C. Merrell, Jr., and Alberg Katko.
Journal of the Water Pollution Control Federation, Vol 38, No 8, p 1310-1318, 1966. 2 fig, 7 tab, 3 ref.

Descriptors: *Recreation, *Recreation facilities, *Water quality, Safety, Boating, Fishing, Water utilization, Oxidation lagoons, Activated sludge, Coliforms, Waste water treatment, Water reuse.
Identifiers: *Fecal coliforms, *Fecal streptoccoci blooms, Santee Recreational Lakes (Calif), California, Water reclamation.

The Santee Project in San Diego County, California, has evolved into a reasonably well-balanced

ecological system utilizing wastewater of the community as the productive source of a central aquatic environment that is socially accepted as recreational lakes. Following conventional activated sludge sewage treatment and a 30-day nominal storage in an oxidation pond, the effluent is pumped to a natural shallow aquifer in the valley above the lakes and later recovered as rising groundwater flow for use in three adjacent recreational lakes. Sand filtration increased removals of organics and nutrients to the 98-99% range. A nutrient balance, a comparison of chemical constituents, bacterial concentrations, and virus findings between the secondary effluent and the lakes is presented. The ecological development of these lakes is summarized; diverse algal population, occasional algal blooms, and fish kills are described. Different facets of the biological life, including phytoplankton, zooplankton, aquatic insects, benthic organisms and fisheries are presented. (Haskins-Wisconsin)
W70-03950

REMOVAL OF SEWAGE NUTRIENTS BY ELECTROLYTIC TREATMENT,
Oslo Univ. (Norway). Inst. of Marine Biology.
Ernst Foyn.
Verhandlungen der Internationalen Vereinigung fur theoretische und angewandte Limnologie, Vol 15, p 569-579, Feb 1964. 6 fig, 5 tab, 5 ref.

Descriptors: *Sewage, *Sludge, *Sewage effluents, *Sewage treatment, Phosphates, Sludge disposal, Electrolysis, Biochemical oxygen demand, Eutrophication, Pilot plants, Ammonia, Nitrogen, Hydrogen ion concentration, Sea water.
Identifiers: Turbidity, Elkem electrolytic process, Reagent recovery, Oslo, Magnesium ions, Oslofjord (Norway), Norway.

The Elkem electrolytic sewage purification process removes raw sewage from sludge, suspended particles, and bacteria, and reduces the content of phosphates to 1.0-1.5 milligram/liter of the effluent. The fraction of removed phosphates depends on the amount of applied electricity, and 200 ampere-hours per cubic meter were found to be most efficacious. The purified effluent was active in reducing the biochemical oxygen demand in untreated sewage. The water content of the sludge was reduced 60% by filtration through open sieves. (Wilde-Wisconsin)
W70-03972

5E. Ultimate Disposal of Wastes

WASTEWATER RATES AND SERVICE CHARGES IN GREAT BRITAIN,
West Hertfordshire Main Drainage Authority, Rickmansworth (England).
For primary bibliographic entry see Field 06E.
W70-03875

MANAGEMENT OF INDUSTRIAL EFFLUENT DISPOSAL IN BRITAIN,
Distillers Co. Ltd., London (England). Dept. of Effluent and By-Products.
For primary bibliographic entry see Field 05D.
W70-03877

BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES: SUMMARY REPORT,
Bechtel Corp., San Francisco, Calif.
E. J. Wasp, T. L. Thompson, P. E. Snoek, J. P. Kenny, and J. C. Carney.
Available from the Clearinghouse as PB-189 756, $3.00 in paper copy, $0.65 in microfiche. Federal Water Pollution Control Administration Research Series Report DAST-16, Dec 1969. 31 p, 13 fig. FWPCA Contract 14-12-156. FWPCA Program 14010 EMS.

Descriptors: *Transportation, *Slurries, *Pipelines, *Waste disposal, Sewage sludge, Land disposal, Continental shelf, Environmental effects, Cost benefit analysis, Institutional constraints, Great Lakes region, Atlantic coastal plain.
Identifiers: Northeast Ohio, Baltimore-Washington, Maintenance dredgings, Fly ash, Water treatment, Plant residues.

This is the summary report of a three volume study principally concerned with the development of regional land and ocean pipeline disposal systems for digested sewage sludge and maintenance dredgings. In Volume I two study cases are presented, namely, a land disposal system for Northeast Ohio (Cleveland-Canton) and an ocean disposal system for the Baltimore-Washington region. A systems approach is used, in which collection, transportation, and disposal aspects are examined in light of technical, economic and social requirements. Various transport modes are compared, including pipeline, ocean tankers, railroads, and trucks. To a lesser extent, the study also considers the expansion of such systems to include fly ash and water treatment plant sludge. In Volume II present methods and costs of disposal for all four wastes are reviewed. Environmental criteria are presented for examining both land and ocean sludge disposal alternatives in terms of general solution for two broad metropolitan regions, namely, the Great Lakes region from Buffalo to Milwaukee and the Atlantic Coast region from Boston to Norfolk. Results of a loop test program utilizing 12 in and 16 in pipe for pumping digested sludge, fly ash, and sludge-fly ash slurries are included in Volume III as well as corresponding rheological tests with a 1/2 in small tube viscometer and a rotational lab viscometer. A procedure for predicting head losses is given, as well as a review of the state of the art of pipelining of waste materials. (See also W70-04005 thru W70-04007)
W70-04004

BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES: VOLUME I - THE WASTE MANAGEMENT CONCEPT.
Bechtel Corp., San Francisco, Calif.

Available from the Clearinghouse as PB-189 757, $3.00 in paper copy, $0.65 in microfiche. Federal Water Pollution Control Administration Research Series Report DAST-16, Vol 1, Sept 1969. IX, 156 p, 33 fig, 31 tab, 14 ref, 4 append. FWPCA Contract No 14-12-156 Project No 14010 EMS.

Descriptors: *Waste disposal, *Sludge disposal, Municipal wastes, Landfills, Systems analysis, Cost-benefit analysis, Sanitary engineering, Waste dumps, Agriculture, Dredging, Land management, Pipelines, Fertilizers, Sewage sludge, Fly ash.
Identifiers: Sludge transport, Solid waste disposal.

Development of a specific waste management system which collects, transports and disposes of sewage sludge and maintenance dredgings in a socially, technically, and economically satisfactory fashion was studied by systems analysis. The feasibility of constructing and operating a demonstration project was examined. A major effort in this area is the demonstration project by the Metropolitan Sanitary District of Greater Chicago using sewage sludge for agriculture. For each detailed study case, a disposal system is proposed which effectively serves regional needs, is economically sound, and includes the collection, transportation and disposal of the estimated production of wastes up to the year 2000. The economics of the systems are presented and recommendations are made as how to achieve both immediate and long-term objectives. For an immediate solution to the national problem of waste disposal of digested sewage sludge, a land disposal system is recommended. A long-term, successful history of beneficially using sludge on land is available. The cost benefit ratio of the sludge disposal system is very favorable. A demonstration project is recommended to prove the viability of the concept. Pipeline transportation is economically better than the other modes evaluated. (See also W70-04004). (Knapp-USGS)
W70-04005

BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES: VOLUME II - CRITERIA FOR WASTE MANAGEMENT,
Bechtel Corp., San Francisco, Calif.
P. E. Snoek.
Available from the Clearinghouse as PB-189 758, $3.00 in paper copy, $0.65 in microfiche. Federal Water Pollution Control Administration Research Series Report DAST-16, Vol 2, Sept 1969. 144 p, 10 fig, 16 tab, 184 ref, append. FWPCA Contract No 14-12-156 Project No 14010 EMS.

Descriptors: *Waste disposal, *Sludge disposal, Municipal wastes, Landfills, Cost-benefit analysis, Sanitary engineering, Waste dumps, Agriculture, Dredging, Fertilizers, Land management, Pipelines, Sewage sludge, Fly ash.
Identifiers: Sludge transport, Solid waste disposal.

Basic environmental criteria were studied for disposal of selected waste materials, including sewage treatment pland sludge, maintenance dredgings, power plant fly ash, and filter plant residues. Both land and ocean disposal alternatives were examined in terms of a general solution for 2 broad regions, namely the Great Lakes Megalopolis from Milwaukee to Buffalo and the Atlantic Coast Megalopolis from Boston to Norfolk. Present methods and costs of disposal have been included to complete the picture of the overall waste disposal problem. (See also W70-0440). (Knapp-USGS)
W70-04006

BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES: VOLUME III - TECHNICAL ASPECTS OF PIPELINING OF WASTE MATERIALS,
Bechtel Corp., San Francisco, Calif.
J. P. Kenny.
Available from the Clearinghouse as PB-189 759, $3.00 in paper copy, $0.65 in microfiche. Federal Water Pollution Control Administration Research Series Report DAST-16, Vol 3, Sept 1969. 167 p, 80 fig, 15 tab, 64 ref, 3 append. FWPCA Contract No 14-12-156 Project No 14010 EMS.

Descriptors: *Sludge disposal, *Hydraulic transportation, *Pipelines, *Hydraulics, *Slurries, Waste disposal, Closed conduit flow, Pipe flow, Turbulent flow, Suspension, Mixing, Fly ash, Sewage sludge, Municipal wastes, Sanitary engineering.
Identifiers: Sludge transport, Solid waste disposal.

The feasibility of using pipelines to transport waste materials, and to develop a reliable procedure for the design of such pipelines was studied. A series of laboratory and pipeline tests was performed. Digested sewage sludge and fly ash were chosen as representative materials for the tests. Both materials, sludge because of its fibrous nature and fly ash because the particles are very fine, were transported in homogenous flow in the turbulent regime. Samples taken from the top and the middle of the pipe test sections confirmed this. These materials, individually and in various combinations, were tested at various velocities in 1/2-inch, 12-inch, and 16-inch pipe test sections, for a number of solids concentrations. Digested sludge, fly ash, and fly ash/sludge mixtures can be successfully transported by pipelines. (See W70-04004). (Knapp-USGS)
W70-04007

CLASS TWO COUNTIES - SEWER DISTRICTS.
For primary bibliographic entry see Field 06E.
W70-04024

5F. Water Treatment and Quality Alteration

PUBLIC HEALTH (MUNICIPAL WATER SUPPLY).
For primary bibliographic entry see Field 03D.
W70-04036

5G. Water Quality Control

COMMUNITIES OF OVER 1,000 POPULATION WITH WATER CONTAINING IN EXCESS OF 1,000 PPM OF TOTAL DISSOLVED SOLIDS,
Black and Veatch, Kansas City, Mo.
For primary bibliographic entry see Field 07C.
W70-03664

BEHAVIOR OF BUOYANT JET IN CALM FLUID,
Hydraulics Research Station, Wallingford (England).
For primary bibliographic entry see Field 08B.
W70-03724

PRIVATE SEWER SYSTEMS.

Ohio Rev Code Ann secs 6112.01 thru 6112.05, 6112.99 (Page Supp 1970).

Descriptors: *Ohio, *Sewage disposal, *Water pollution control, *Eminent domain, Sewage, Legislation, Wastes, Sanitary engineering, Waste disposal, Sewage districts, Sewers, Waste water disposal, Pollution abatement, Condemnation, Local governments, Administrative agencies, Planning.

Any person may apply to the Department of Health for approval of plans for the construction of a sewage disposal system to serve any geographical area not served by another system. The application must include data establishing the need for the system, as well as surveys and maps necessary to determine the boundaries of the area to be served. The local board of county commissioners certifies that the area is not served by another system. After receiving notice from the Public Utilities Commission that an authorizing certificate has been issued, the Department may act on the application. Construction of the facilities must be supervised by a registered engineer. Any board of county commissioners may purchase or appropriate any system constructed under these sections within its county. The appropriation procedure is the same as the one provided for use by municipal corporations. Maximum penalty for violating these sections is five hundred dollars. (Douberley-Florida)
W70-03736

SEWER DISTRICTS.
Ohio Rev Code Ann sec 6117.01 (Page, 1953), as amended, (Supp 1970).

Descriptors: *Ohio, *Sewage districts, *Sewers, *Waste disposal, Legislation, Sewage, Sanitary engineering, Sewage disposal, Sewage treatment, Waste water disposal, Outlets, Ditches, Channels, Public health, Regulation, Planning, Project planning, Administrative agencies.

Boards of county commissioners may establish and maintain sewer districts within their counties and outside of municipal corporations. The boards may acquire, construct, maintain and operate sewers, ditches or channels within their district and any other works within and without such districts as are necessary to carry water to a proper outlet for treatment or disposal. Any board may employ a sanitary engineer and establish a sanitary engineering department. The boards may enact rules and regulations concerning: (1) sewer systems outside municipal corporations; (2) sewer systems inside municipal corporations when they are operated by the board; or (3) municipal corporations' sewer systems which discharge into facilities operated by the board. No sewers or treatment plants may be constructed outside municipal corporations without approval of the plans by the board and supervision of the construction by the county sanitary engineer. (Douberley-Florida)
W70-03737

SEWERS AND WATERWORKS.
Tenn Code Ann secs 6-1401 thru 6-1439 (1956), as amended, (Supp 1969).

Descriptors: *Tennessee, *Sewers, *Water works, *Cities, Legislation, Legal aspects, Eminent domain, Construction, Maintenance, Damages, Public health, Wastes, Water supply, Sewage disposal, Pumping plants, Treatment facilities, Storage, Water purification, Costs, Administrative agencies, Contracts, Financing, Land tenure, Waste disposal, Sewage treatment, Operation and maintenance, Supervisory control (Power).
Identifiers: *Water systems, Bonds.

All cities are authorized to condemn property and property rights for the purpose of constructing, laying, repairing or extending sewers, water systems or drainage ditches. In order to protect the public health and assure the payment of sewer bonds, cities may require occupants of land abutting sewer systems to connect to such systems and be charged for the use thereof. Two cities may contract for one to use the sewer and water system of the other, or for the joint construction and use of such a system. Every city is authorized to own and operate a waterworks system and a sewerage system. A waterworks system includes supply sources, pumping facilities, purification works, storage facilities and a distribution system. A sewerage system includes a collecting system, intercepting and outfall sewers, pumping stations and treatment, purification and disposal plants. Every city acquiring a waterworks or sewerage system is required to establish a board to have supervision and control of construction and operation of such works. The board will advise the city regarding the necessity of the financing and acquisition of land for new works. The financing of works is provided for by rate collection, bond issuance and other means. (Keith-Florida)
W70-03748

POWERS UNDER CITY MANAGER CHARTER.
For primary bibliographic entry see Field 06E.
W70-03749

SEWER DISTRICTS: ST. LOUIS COUNTY.

Mo Ann Stat secs 249.010 thru 249.420 (1959).

Descriptors: *Missouri, *Sewage districts, *Sanitary engineering, *Taxes, Construction, Maintenance, Sewerage, Public health, Sewers, Assessments, Judicial decisions, Human population, Boundaries (Property), Drainage, Surveys, Maps, Costs, Administrative agencies, Compensation, Interest, Debt, Financing, Contracts, Laterals, Sewage disposal, Legislation, Pollution.

The circuit court may establish a sewer district for the construction and maintenance of a sewer system in St. Louis County upon petition of, and approval by, the residents of the proposed district. After the filing of such petition, the judge shall appoint a sanitary engineer to establish boundaries, make surveys and maps, and prepare a plan for sewer construction in the proposed district. A general election shall be held to approve taxes to be levied, indebtedness to be incurred, and selection of the district trustees. If approved, the trustees may issue bonds and assess taxes to pay expenses of the district. The boundaries of this district may be extended. Qualifications for trustees, the method of their selection, and administrative procedure to be followed are provided. The trustees may: (1) employ an engineer to develop sewer plans; (2) construct and maintain all necessary sewer structures and systems; (3) make necessary contracts; (4) acquire property by condemnation or otherwise; (5) construct sewerage disposal plants; (6) employ and compensate necessary personnel; (7) establish subdistricts with lateral sewer systems; and (8) collect rent from property abutting said lateral sewers. (Dearing-Florida)
W70-03767

SANITARY DRAINAGE DISTRICTS-CITIES OVER 300,000 INHABITANTS AND ADJOINING COUNTIES.
Mo Ann Stat secs 248.010 thru 248.200 (1959).

Descriptors: *Missouri, *Drainage districts, *Sanitary engineering, *Sewers, Construction, Maintenance, Drainage systems, Channels, Administrative agencies, Judicial decisions, Civil engineering, Drains, Surveys, Maps, Expenses, Compensation, Outlets, Taxes, Assessments, Legislation, Legal aspects, Drainage programs, Sewage, Right-of-way, Easements, Condemnation, Contracts.
Identifiers: *Sanitary districts.

A sanitary district may be established and incorporated by the circuit court whenever the construction and maintenance of a channel or system of drains or sewers is needed for the drainage of any area. Three commissioners appointed by the court shall supervise the district. They shall formulate plans for the drainage system, and if approved by the voters in the district, the court shall order the district to be established. Districts may include more than one county. Selection procedures for a board of trustees of the district are provided. The board may divide the districts into independent subdistricts. The district may acquire rights-of-way or easements by requesting condemnation proceedings by the proper city or county authority. The board of trustees may let contracts for all proposed works. A special tax may be levied on lands within the district and bonds may be issued to pay district expenses. Sewers and special drains may be constructed and funded from special taxes on the areas benefited. The district shall be dissolved when the necessary drainage is completed. (Dearing-Florida)
W70-03768

LIQUIDATOR FOR SEWER DISTRICTS IN CERTAIN COUNTIES.

Mo Ann Stat secs 249.670 thru 249.700 (1959).

Descriptors: *Missouri, *Sewage districts, *Administration, *Decision making, Judicial decisions, Administrative agencies, Taxes, Costs, Government finance, Payment, Debt, Compensation, Legislation.

Whenever any sewer districts with a population greater than seven hundred thousand but less than seven hundred and fifty thousand is dissolved, the Governor shall appoint a liquidator of such sewer district. The liquidator shall have all powers and duties of the board of supervisors of the district subject to approval by the circuit court. The officers and supervisors of the district shall cease to have any further power or duties. The liquidator shall have the power to dispose of all property and effects of the district, contest any action against the district, and compromise any taxes or indebtedness of the district. (Dearing-Florida)
W70-03769

HEALTH AND SAFETY (PUBLIC WATER SUPPLY AND SEWER SYSTEM).
Tenn Code Ann secs 53-2001 thru 53-2016 (1966), secs 53-2017 thru 53-2022 (Supp 1969).

Descriptors: *Tennessee, *Water works, *Water supply, *Public utilities, Water distribution (Applied), Water utilization, Sewage, Pumping plants, Sanitary engineering, Sewage disposal, Sewage dis-

tricts, Sewage treatment, Environmental sanitation, Septic tanks, Drains, Engineering structures, Legislation, State governments, Regulation, Permits, Public health, Operation and maintenance.

The Department of Public Health controls and supervises construction and operation of public water supplies and sewerage systems. All cross-connections and interconnections between primary and auxiliary water supplies must be approved by the Department. The Department may order corrective action to be taken by the operator of any water supply or sewerage system that constitutes a health menace. Procedures are outlined for judicial review of Department orders. The Department is empowered to exercise general supervision over the construction and operation of individual sewage disposal systems for proposed housing subdivisions where public sewage systems are not available. This authority does not exist within city limits. Local health officers are directed to carry out the provisions of this act. Criminal penalties are prescribed for violation of the act. State grants can be made to municipalities for the construction of sewage treatment works. The Department may enter into contracts with municipalities for the construction of proposed water projects. A sewage treatment works account is established to fund authorized activities of the Department. (Barnett-Florida)
W70-03780

SOME EFFECTS OF SHADE COVER ON STREAM TEMPERATURE IN SOUTHEAST ALASKA,
Forest Service (USDA), Juneau, Alaska. Pacific Northwest Forest and Range Experiment Station.
William R. Meehan.
USDA Forest Serv Res Note PNW-113, 1970. 9 p, 1 fig, 4 tab, 6 ref.

Descriptors: *Water temperature, *Vegetation effects, *Aquatic environment, Microclimatology, Alaska, Riparian plants, Watershed management, Cutting management.
Identifiers: Streamside vegetation, Shade effects.

Water temperature differences measured with a precision resistance thermometer over 20-yard intervals show that on clear summer days, shade-producing streamside vegetation is important in cooling or maintaining coolness of small streams. The average temperature increase in unshaded reaches of streams in the Haines-Juneau area was 0.071 deg C. and in the Petersburg-Wrangell area it was 0.164 deg C. In shaded reaches the average temperature decrease was 0.060 deg C. and 0.081 deg C., respectively. Under overcast skies, the effects of shade were very small and the trend was for a slight temperature increase over 20-yard stream reaches--0.011 deg C. and 0.009 deg C., in the two areas. The reasons for the significantly different temperature responses in the two geographic areas are not yet known. (Helmers-Forest Service)
W70-03819

EXAMINATION INTO THE EFFECTIVENESS OF THE CONSTRUCTION GRANT PROGRAM FOR ABATING, CONTROLLING AND PREVENTING WATER POLLUTION.

Report to Congress, Nov 3, 1969. 164 p, 7 fig, 12 append.

Descriptors: *Systems analysis, *Water quality control, *Pollution abateness, *Planning, *Mathematical models, Decision making, Alternative costs, Waste water treatment, Water utilization scheduling.
Identifiers: Alternative schedules.

The study examined the effectiveness of the construction grant program administered by the Federal Water Pollution Control Administration for abating, controlling and preventing water pollution in the United States. The development and use of a systems analysis method, and its practicability in an actual waterway was discussed. A mathematical model was developed by Camp, Dresser and McKee and used to evaluate data on the Merrimack River for estimating the construction costs of water treatment facilities for various degrees of water quality. It was concluded that through the use of the systems analysis approach to planning and implementing water pollution programs (a) a least-cost construction plan to achieve water quality standards could be made, (b) more costly but perhaps desirable alternative schedules could be developed and (c) decision makers would be provided with more meaningful data as to enable them to achieve established objectives and the costs of providing various levels of water uses. (Thiuri-Cornell)
W70-03936

SIMULATION MODEL FOR FLOW AUGMENTATION COSTS,
Florida Univ., Gainesville; and Massachusetts Inst. of Tech., Cambridge.
Armando I. Perez, John C. Schaake, and Edwin E. Pyatt.
J Hydraul Div, Proceedings of ASCE, Vol 96, No HY1, p 131-142, Jan 1970. 1 fig, 6 ref, 2 append.

Descriptors: *Simulation analysis, *Sewage treatment, *Flow augmentation, *Optimization, *Regression analysis, Storage capacity, Costs, Reservoirs, Water quality, Streamflow, Computers.

A generalized mathematical model was developed to permit the simulation of the economic and physical interactions of sewage treatment and low flow augmentation, and subsequent evaluation from a water quality standpoint. An essential phase of the project, a study of low flow augmentation storage costs was analyzed. The main objective was to obtain optimum functional relationships between the storage volume required and those variables that were found to affect it. The results could then be integrated with regional cost curves to give generalized cost expressions. Initially, monthly streamflow and demand records were generated from historical data by a computer program. The operation of various reservoir sizes was simulated and the number of deficiencies during the time period considered were counted. After this process was repeated for several combinations of values of the variables, the desired regression, or the 'best fit', equation was derived which related storage volume required to these parameters. (Thiuri-Cornell)
W70-03940

ECONOMIC ANALYSIS IN WATER QUALITY MANAGEMENT,
Washington Univ., Seattle.
For primary bibliographic entry see Field 06B.
W70-04000

BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES: VOLUME I - THE WASTE MANAGEMENT CONCEPT.
Bechtel Corp., San Francisco, Calif.
For primary bibliographic entry see Field 05E.
W70-04005

BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES: VOLUME II - CRITERIA FOR WASTE MANAGEMENT,
Bechtel Corp., San Francisco, Calif.
For primary bibliographic entry see Field 05E.
W70-04006

BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES: VOLUME III - TECHNICAL ASPECTS OF PIPELINING OF WASTE MATERIALS,
Bechtel Corp., San Francisco, Calif.
For primary bibliographic entry see Field 05E.
W70-04007

SEWERAGE - WATER WORKS.

Mo Ann Stat secs 250.010 thru 250.250 (1959).

Descriptors: *Missouri, *Public health, *Sewage districts, *Water pollution control, Water works, Legislation, Legal aspects, Cities, Construction, Maintenance, Treatment facilities, Waste disposal, Sewers, Water purification, Liquid wastes, Solid wastes, Industrial wastes, Domestic wastes, Administrative agencies, Costs, Assessments, Taxes, Financing, Rates, Planning, Leases, Pollution abatement, Water supply, Water quality.
Identifiers: *Bonds, *Sewer districts, Improvements.

Cities and sewer districts are authorized to acquire, construct, improve, extend, maintain and operate sewerage systems for the protection of the public health. 'Sewerage system' means storm water systems, sanitary systems, sewerage systems, sewerage treatment plants and collection, purification and disposal facilities. Two or more cities are authorized to operate combined waterworks and sewerage systems. Cities may delegate to their boards of public works the responsibility for and control of combined systems. The cost to any city or sewer district of acquiring, constructing, improving or extending a sewerage system or combined system will be financed through tax levies, assessments, general revenue funds or bond issuances. Cities and sewer districts are authorized to charge reasonable rates for the use of their sewerage systems. Cities may charge industrial establishments for the operation by the city of sewerage facilities to abate or reduce industrial water pollution. It is the purpose of this chapter to enable cities and sewer districts to protect the public health and welfare by preventing or abating water pollution and by supplying wholesome water. Cities and sewer districts are empowered to do all things necessary to carry out these purposes. (Keith-Florida)
W70-04025

THE FUTURE OF THE NORTH CAROLINA COASTAL AREA.

National Estuarine Pollution Study, The Future of the North Carolina Coastal Area, p 1-12 (1969).

Descriptors: *North Carolina, *Estuaries, *Water pollution, *Administration, Management, Water policy, Water resources development, Water zoning, Regulation, State governments, Aquatic habitats, Estuarine fisheries, Estuarine environment, Oceanography, Local governments, Federal government, Fish management, Project planning, Recreation, Impaired water quality, Pollutants, Legal aspects.

The responsibility for regulation of North Carolina's estuaries should rest with state and local governments. The federal government should provide guidance, advice, and services only where the problems are beyond the capability of the state. Some commentators would prefer federal control of estuaries. Planned zoning should be used to prevent pollution resulting from indiscriminate development and filling in estuarial areas. A comprehensive system of land and water management should be implemented. Burgeoning industry in estuarine areas should be regulated to prevent pollution, but unduly restrictive water quality standards might damage the state's economy. Pollution of estuaries injures the fish population. Recreational uses of waterways require clean water. Uniformity of laws controlling waste from pleasure craft is necessary. Tourism is a large factor in the economy of North Carolina. Research in environmental ecology is best conducted by universities. Studies should be made of: (1) the biological contributions of estuaries to continental shelf waters, (2) the environmental effects of pesticides, (3) the assimilation capacities of the sounds, (4) the biological effects of industrial and domestic wastes, and (5) a comparison of the water levels in estuaries and the sea. (Dye-Florida)
W70-04032

GENERAL SEWER SYSTEM.
Mo Ann Stat sec 88.801 (Supp 1970).

Descriptors: *Missouri, *Sewage disposal, *Municipal wastes, *Taxes, Assessments, Government finance, Sewage districts, Sewage treatment, Sewers, Environmental sanitation, Wastes, Waste water disposal, State governments, Legislation, Cities, Regulation.

All cities in this state containing more than ten thousand and less than thirty thousand inhabitants and possessing special charters are empowered to establish general sewer systems. There are four classes of sewer systems: public, district, joint district, and private. Public sewers shall be established along principal courses of drainage at such time, to such extent, of such dimensions and under such regulations as provided by municipal ordinance. The city may levy a 'special public sewer tax' over all taxable property within the city. (Dye-Florida)
W70-04033

PRIVATE SEWERS.
Mo Ann Stat secs 88.813 thru 88.817 (1952).

Descriptors: *Missouri, *Sewage disposal, *Municipal wastes, *Sewage districts, Assessments, Government finance, Sewage treatment, Sewers, Environmental sanitation, Wastes, Waste water disposal, State governments, Legislation, Legal aspects, Regulation, Cities, Condemnation.

Private sewers may be connected to public or district sewers and regulated by city ordinance. The city shall not assume the costs of construction, repair, or cleaning of private sewers. Expenses incurred for maintenance of district and joint district sewers are paid out of the general appropriation for that purpose. The city may condemn property necessary for the construction of any sewer. Where a sewer is laid on uncondemned property, the city may be compelled by mandamus or other appropriate action to exercise its right of condemnation. (Dye-Florida)
W70-04034

PRIVATE SEWERS.
Mo Ann Stat sec 64.300 (1966).

Descriptors: *Missouri, *Sewers, *Sewage, *Odor, Domestic wastes, Legislation, Sewage disposal, Sewage effluents, Ditches, Recreation, Recreation facilities, Condemnation, Closed conduits, Disposal, Open channels, Remedies, Regulation, Legal aspects.
Identifiers: Penalties (Criminal).

All sewers and ditches used for carrying raw sewage or effluent from land located near recreation areas in certain counties are required to be fully enclosed. If any such sewer or ditch emits offensive and unhealthy odors, it shall be considered a nuisance and condemned as such. The condemned sewers and ditches may not be used for carrying raw sewage and effluent until all causes of the odors are completely eliminated. Any person found guilty of using any open ditch or sewer after it has been condemned shall be guilty of maintaining a nuisance. A maximum penalty of $1,000 and one year's imprisonment is provided. (Schram-Florida)
W70-04040

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

DETERMINATION OF OPTIMAL FLOOD PROTECTION LEVELS WITH SMALL EXCEEDANCE PROBABILITIES,
Carnegie-Mellon Univ., Pittsburgh, Pa.
Richard M. Shane, and Donald P. Gaver.
Water Resources Research, Vol 5, No 6, p 1223-1228, Dec 1969. 6 p, 1 fig, 2 tab, 4 ref, append.
NSF Grants GP-8824 and GK-1482.

Descriptors: *Probability, *Flooding, *Frequency analysis, *Statistical methods, Regression analysis, Markov processes, Forecasting, Economics, Cost-benefit analysis, Statistical models, Correlation analysis.
Identifiers: *Flood frequencies.

A technique for selecting flood protection levels that exceed mean flood intensities by a large amount is based on a probability model derived from the assumption that base flow floods occur at random with exponentially distributed magnitudes. It is a parametric approach involving the estimation of two statistical parameters by the method of maximum likelihood. The sensitivity of the results to errors made in choosing the correct flood intensity distribution is examined by computing the loss when the flood intensities are log normally distributed. This loss is shown to be small over a wide range of parameter values likely to be encountered. Through the use of a quadratic loss function it is shown that the expected loss is inversely proportional to the length of record. Furthermore if the existing level of protection exceeds the mean peak flood intensity by a large amount, then parameter estimation losses can be quite large, even when a record of considerable length is available. The quadratic loss function also demonstrates that the loss is due primarily to errors in estimating the expected flood intensity. (Knapp-USGS)
W70-03653

USE OF THE CRITICAL PERIOD IN RESERVOIR ANALYSIS,
California Univ., Los Angeles.
For primary bibliographic entry see Field 04A.
W70-03655

DEVELOPMENT OF MATHEMATICAL MODEL AND COMPUTER PROGRAM FOR OPTIMIZATION OF VERTICAL TUBE EVAPORATOR SALINE WATER PLANTS,
Houston Research Inst., Inc., Tex.
For primary bibliographic entry see Field 03A.
W70-03665

POINT RAINFALL FREQUENCIES IN CONVECTIVE STORMS,
Arizona Univ., Tucson.
For primary bibliographic entry see Field 02B.
W70-03673

AN EXAMINATION OF LINEAR HOMOGENEITY OF TRADE AND PRODUCTION FUNCTIONS IN COUNTY LEONTIEF MATRICES,
Pennsylvania State Univ., University Park.
Wesley H. Long.
Journal of Regional Science, Vol 9, No 1, p 47-67, Apr 1969. 21 p, 1 fig, 11 tab, 10 ref.

Descriptors: *Leontief models, Regional analysis, Homogeneity, Forecasting, Regression analysis, Input-output analysis, Economics.
Identifiers: *Linear homogeneity, *Trade, *Production function, *Leontief matrices, *Leontief's assumptions, Leontief functions, Leontief coefficients, Regional economics, Bias, Impact analysis.

Leontief's simplifying assumptions about the nature of production functions have allowed the power of linear algebra to be applied to the empirical solution of various models concerning interdependence among producers in an economy. In regional economics the Leontief assumptions have been applied to trade functions, where matrices describe trade relations among industries in a region, as well as to production functions, where matrices describe technological relations among industries. In either case the inverse of the coefficient matrix is used to make forecasts and impact analyses. These projections are predicated on the linearity and homogeneity of the production or trade function. The purpose of this paper is to examine these two simplifying assumptions by means of a regression analysis of cross-section data for a limited number of expenditures made by various sectors of a county economy. Tests of these assumptions have been made before and the justification for the present investigation is that it approaches the question differently and that it is concerned with a small region. Input-output analysis has been used fairly extensively in the water area. Recently studies have used this method to study water resources in the Western States and this study may provide the basis for an input-output water study for small geographic areas. (Loeb-Rutgers)
W70-03824

A GENERALIZATION OF THE CES PRODUCTION FUNCTION,
Oklahoma State Univ., Stillwater; and Iowa State Univ., Ames.
Yao-chi Lu, and Lehman B. Fletcher.
The Review of Economics and Statistics, Vol 50, No 4, p 449-452, Nov 1968. 4 p, 7 ref.

Descriptors: *Return to scale.
Identifiers: *CES production function, *VES production function, Elasticity of substitution, Marginal rate of substitution, Cobb-Douglas function.

The main weakness of the CES (constant elasticity of substitution) production function seems to be the empirical starting point. The derivation of the CES function is based on the assumption that the partial regression coefficient of log K/L is equal to zero. The authors feel that the above assumption is not realistic. This position is supported by their empirical findings. The purposes of this paper are: (1) to derive a more general form of the production function that does not depend upon the above assumption and which has the property of a variable elasticity of substitution, (2) to examine the elasticity of substitution of the new function, and (3) to present some evidence of the desirability of using the new function. Production functions can be applied to water supply analysis and the CES and VES (variable elasticity of substitution) functions may prove to be useful specifications of water production and supply functions. (Loeb-Rutgers)
W70-03829

LOCATIONAL EQUILIBRIA,
Michigan Univ., Ann Arbor.
Edward E. Leamer.
Journal of Regional Science, Vol 8, No 2, 229-242, Winter 1968. 14 p, 14 fig, 6 ref.

Descriptors: Demand, Supply, Costs.
Identifiers: *Locational equilibria, Transportation cost function, Objective function, Demand densities, Trade, Market areas, Cournot model.

A fixed demand distributed throughout a plane may be met by the establishment of supply points or sources at various locations. Innumerable situations of this type occur and examples are immediate: airports, warehouses, post offices, etc. This paper presents source location optima for two families of demand densities. In addition, the author develops a simple mathematical formula relating the transport cost to the number of optimally located sources. Extensions and applications of the formula are discussed. The author shows that economic borders which fracture an otherwise uniformly continuous demand do not cause enough distortion in the optimal allocation of sources to induce significant increases in transport costs. As such, this article might be helpful in locating water reservoirs with respect to actual or projected demand densities and conditions. (Loeb-Rutgers)
W70-03839

AN EXTENSION OF THE GENERALIZED WEBER PROBLEM,
Washington Univ., St Louis, Mo.
Leon Cooper.
Journal of Regional Science, Vol 8, No 2, p 181-197, Winter 1968. 17 p, 1 fig, 2 tab, 7 ref, 1 append.

Descriptors: Costs, Distance, Digital computers.
Identifiers: *Generalized Weber problem, Transport distance, Iteration, Local minima, Location studies.

Several papers have independently presented methods for solving the generalization of the Weber problem, i.e., finding a single point (origin or source) in two-dimensional Euclidean space which is the minimum transport distance and/or cost point for any number of destination points. A mathematical statement of the generalization of the simple Weber problem is given. In this paper the author is concerned with a modification of the problem to find the point (x,y) such that the sum of distances or costs proportioned to distances are a minimum. The modification concerns the fact that in realistic situations the cost of shipment or servicing may not be simply proportional to distance (with weights). In some situations it would be more appropriate to assume that the costs were proportional to distance raised to some power. This greater flexibility in realistically and accurately fitting cost data. Such an analysis might be applicable in the water area particularly in situations of designing efficient water pipe line services. (Loeb-Rutgers)
W70-03840

TRENT BASIN STOCHASTICS,
Manchester Univ. (England). Dept. of Engineering.
For primary bibliographic entry see Field 02E.
W70-03902

GENERALIZED DROUGHT SEQUENCE PROBABILITIES FOR STORAGE-DRAFT-FREQUENCY ANALYSIS,
University of the Witwatersrand, Johannesburg (South Africa). Dept. of Hydraulic Engineering.
For primary bibliographic entry see Field 02E.
W70-03904

EFFECTS OF INCONSISTENCY AND NON-HOMOGENEITY ON HYDROLOGIC TIME SERIES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-03905

THE BAYES METHODS OF STATISTICAL HYDROLOGY (FRENCH),
Electricite de France, Chatou. Centre de Recherches et d'Essais.
For primary bibliographic entry see Field 02A.
W70-03906

EFFECTS OF SAMPLING INTERVAL, PERIODICITY, DEPENDENCE AND SKEWNESS ON EXTREME VALUES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-03910

EXAMINATION INTO THE EFFECTIVENESS OF THE CONSTRUCTION GRANT PROGRAM FOR ABATING, CONTROLLING AND PREVENTING WATER POLLUTION.
For primary bibliographic entry see Field 05G.
W70-03936

RESERVOIR SYSTEM DESIGN OPTIMIZATION,
Esso Research and Engineering Co., Florham Park, N.J. Environmental Control.
For primary bibliographic entry see Field 04A.
W70-03941

SURVEYS OF ECONOMIC THEORY, RESOURCE ALLOCATION, VOLUME III.
For primary bibliographic entry see Field 06B.
W70-03990

OPERATIONS RESEARCH,
Harvard Univ., Cambridge, Mass.
Robert Dorfman.
Surveys of Economic Theory, Resource Allocation, Vol III, p 29-74, Macmillan, London, England, 1966. 46 p, 5 tab, 40 ref.

Descriptors: *Operations research, Mathematical models, Linear programming, Systems analysis, Probability, Model studies.
Identifiers: Measure of merit, Information theory, Inventory models, Objective function.

The operations analyst, in contrast with the conventional business analyst, has a predilection for formulating his problems by means of formal mathematical models. By a model, the author means a symbolic description of a phenomenon in which its observable characteristics are deducted from simple explanatory first principles by manipulating symbols in accordance with the laws of some formal logic. Such analysts have a preference for symbolic, as opposed to verbal, modes of expression and reasoning. Operations research is not a descriptive science but a prescriptive one. A major part of the task of the operations analyst is to construct a 'measure of merit' for the operation he studies to accompany his formal description of it. The logical precision of the model enforces corresponding precision in expressing the objectives that the operation is intended to attain. The author discusses a number of aspects of the problem of model formulation. Then the problems of determining measures of merit or objective functions are examined. Operations research can be used advantageously in many sectors of the water area, examples would be water pricing, simulation models and demand forecasting. This article provides a general reference for the water researcher interested in using operations research methods. (See W70-03990). (Loeb-Rutgers)
W70-03992

LINEAR THEORY,
All Souls Coll., Oxford (England).
J. R. Hicks.
Surveys of Economic Theory, Resource Allocation, Vol III, p 75-113, Macmillan, London, England, 1966. 39 p, 4 fig.

Descriptors: Linear programming, Input-output analysis, Mathematical studies, Equations.
Identifiers: *Linear theory, Activity analysis, Game theory, Duality Theorem, Convexity.

The subject which the author discusses in this article concerns the group of techniques of linear programming, activity analysis, input-output, and theory of games. It is apparent, from the most casual inspection of these topics, that they are closely related. Further examination shows that they can be set around a recognizable core, which may be regarded as a restatement of a central part of conventional economic theory. It is the object of the author to isolate this core and to consider what there is that the economist, who has no intention of becoming a practitioner of the techniques, may learn from it. The phenomenon which is examined is the application to economics of a new kind of mathematics. This article has relevance to the water area in view of extensive use of these mathematical techniques in this sector. (See W70-03990). (Loeb-Rutgers)
W70-03993

BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES: VOLUME I - THE WASTE MANAGEMENT CONCEPT.
Bechtel Corp., San Francisco, Calif.
For primary bibliographic entry see Field 05E.
W70-04005

BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES: VOLUME II - CRITERIA FOR WASTE MANAGEMENT,
Bechtel Corp., San Francisco, Calif.
For primary bibliographic entry see Field 05E.
W70-04006

BULK TRANSPORT OF WASTE SLURRIES TO INLAND AND OCEAN DISPOSAL SITES: VOLUME III - TECHNICAL ASPECTS OF PIPELINING OF WASTE MATERIALS,
Bechtel Corp., San Francisco, Calif.
For primary bibliographic entry see Field 05E.
W70-04007

6B. Evaluation Process

RELATIVE IMPORTANCE OF VARIABLES IN WATER RESOURCES PLANNING,
Geological Survey, Washington, D.C.; and Resources for the Future, Inc., Washington, D.C.
I. C. James, II, B. T. Bower, and N. C. Matalas.
Water Resources Research, Vol 5, No 6, p 1165-1173, Dec 1969. 9 p, 2 fig, 4 tab, 13 ref.

Descriptors: *Planning, *Water resources development, *Statistical models, Statistical methods, Non-structural alternatives, Simulation analysis, Forecasting, Water quality, Estuaries, Model studies, Mathematical models, Markov processes, Probability, Economics, Legal aspects, Social aspects, Political aspects, Synthetic hydrology, Water pollution, Water supply.
Identifiers: *Sensitivity analysis, *Potomac River Estuary.

Four variables involved in the water resources planning decision characterized by hydrology, modeling of dissolved oxygen behavior in an estuary, projection of economic development, and water quality objective, were tested for sensitivity in the evaluation of a water resources system's performance. The results were obtained assuming a 25% range in economic projection, 1 mg/liter range in the dissolved oxygen objective, two separately developed models of estuarial dissolved oxygen behavior, and 50- and 10-year sequences of hydrologic data. The results of simulations of system operation with the different values of the planning variables were subjected to a four-way analysis of variance to partition the variance attributable to each planning variable. For the system under consideration, the relative importance of the variables in descending order is: (1) economic development projection, (2) water quality objective, (3) dissolved oxygen modeling, and (4) hydrology. (Knapp-USGS)
W70-03656

BIBLIOGRAPHY ON SOCIO-ECONOMIC ASPECTS OF WATER RESOURCES,
Battelle Memorial Inst., Columbus, Ohio.
H. R. Hamilton, D. H. Owens, T. E. Carroll, A. R. Glenn, and B. A. Gilmour.
Available from the Clearinghouse as PB-189 420, $3.00 in paper copy, $0.65 in microfiche. Department of Interior, Office of Water Resources Research Bibliography, Mar 1, 1966. 453 p, 770 ref, append, 2 index. OWRR Contract No 14-01-0001-822.

Descriptors: *Bibliographies, *Abstracts, *Economics, *Social aspects, *Water resources, Social impact, Recreation, Water resources development, Water pollution control, Cost-benefit analysis, Conservation, Control, Costs,

Data collections, Desalination, Planning, Management.
Identifiers: Socio-economic aspects.

The purpose of this annotated bibliography is to ease the task of those desiring to review the literature pertaining to the economic aspects of water. The bibliography includes, but is not limited to, the literature in the following areas of interest: (1) The supply of and demand for water of various qualities including the competitive uses for industry, domestic, and recreation; (2) methods and applications of cost/benefit analysis, including those involving multiple-purpose water projects; (3) economic impact of water resources and water development projects; and (4) methods of determining economic values of sport fisheries, wildlife, and other aquatic outdoor recreation resources, as well as material on the social values of water-based outdoor recreation. The abstracts prepared for this bibliography are brief, noncritical, and indicative in nature. Each abstract has been given an identifying number, and has been indexed not only in terms of the central theme of the article, but also in terms of the material which is presented in support of the central theme. Following each abstract, all of the index terms deemed relevant to the article have been listed. In the subject index for this publication, two objectives were considered: (1) a comprehensive index for the immediate users, and (2) a deeper index for possible future inclusion in a computerized coordinate index system. (Knapp-USGS)
W70-03714

CONSERVING RESOURCES AND MAINTAINING A QUALITY ENVIRONMENT,
Agricultural Research Service, Beltsville, Md. Soil and Water Conservation Research Div.
For primary bibliographic entry see Field 05B.
W70-03823

A COMPARATIVE ANALYSIS OF THE NET PRESENT VALUE AND THE BENEFIT-COST RATIO AS MEASURES OF THE ECONOMIC DESIRABILITY OF INVESTMENTS,
British Columbia Univ., Vancouver.
Bernhard Schwab, and Peter Lusztig.
Journal of Finance, Vol 24, No 3, p 507-516, June 1969. 10 p, 3 fig, 10 ref.

Descriptors: *Cost-benefit ratio, *Investment, Constraints, Risks.
Identifiers: *Netted present value, *Present value, Economic desirability, Aggregate benefit-cost ratio, Netted benefit-cost ratio, Utility analysis.

Recent contributors in managerial finance have largely been concerned with the more challenging issues of valuation and capital structure. As a consequence, several controversial but less provoking issues remain shelved and unresolved. This paper is essentially directed at one such issue, the merits of alternative criteria for measuring the economic desirability of investments (both individual investment propositions and aggregate investment portfolios). The particular issue is the comparison of the net present value with various benefit-cost ratios. While these measures are based on the same fundamental concept, recognizing the time value of money, and are, therefore, related to each other, they are different enough to yield contradictory results in a number of situations. It is the purpose of this article to analyze systematically all these various measures of economic desirability, defining the conditions under which they yield equivalent results and the conditions under which their results are contradictory, and as a consequence, to determine the validity of their application to the economic evaluation of investments. Such an analysis should lend itself to the evaluation of investments in the water area. (Loeb-Rutgers)
W70-03825

COPING WITH UNCERTAINTY IN THE MAKE OR BUY DECISION,
Marquette Univ., Milwaukee, Wis.
Lloyd D. Doney.
Management Accounting, Vol 50, No 2, p 31-34, Oct 1968. 4 p, 7 tab.

Descriptors: *Risks, *Decision making, Probability, Fixed costs, Costs, Industrial production.
Identifiers: *Make or buy decision, Decision cost, Probability weighing, Decision matrix.

The make or buy decision analysis is usually presented in an oversimplified manner in order that full attention may be given to the significant fact that decision-making most often requires a collection of figures that differ from those that are appropriate for purposes of income determination and inventory valuation. In pursuing this line of emphasis, the circumstances of the make or buy decision under consideration are usually void of any consideration of the uncertainty that typically surrounds the decision-making process in real situations. The purpose of this investigation is to add an uncertainty dimension to the typical make or buy decision analysis. A hypothetical example is given so as to demonstrate this extension of the make or buy decision analysis. This analysis might be applicable to the water area where uncertainty in both demand, supply and investment decisions is a prominent factor. (Loeb-Rutgers)
W70-03826

INVESTMENT RETURNS BEFORE AND AFTER TAX,
Michigan Univ., Ann Arbor.
Harry Benford.
The Engineering Economist, Vol 10, No 4, p 1-16, Summer 1965. 16 p.

Descriptors: *Profits, *Taxes, *Costs, Investment, Operating costs, Interest rate, Financing, Loans, Depreciation, Economics, Cost repayment, Capital.
Identifiers: *Corporations, *Rate of return, Disposal value, Equity capital, Fast write-off.

This article attempts to explain the influence of the corporate profits tax on levels of profitability and the annual cost of capital. This topic should be of interest to the water resource planner due to the corporate structure of many water utilities and the effects of the tax as felt throughout the entire economy, (i.e. through changes in the price of capital). The author considers a simple case where the depreciation period for taxes equals the life of the investment, the investment is all equity capital and there is a negligible disposal value. He then moves on to the case where the depreciation period for taxes may be shorter than the probable useful life of the investment and the investment is raised throughout a bank loan. The last case studied is that where the depreciation period exceeds the loan period. The author concludes with some numerical examples to illustrate the concepts developed. (Murphy-Rutgers)
W70-03827

MAXIMUM PROSPECTIVE VALUE CRITERION,
Stanford Univ., Calif.
R. V. Oakford, and G. J. Theusen.
Engineering Economist, Vol 13, No 3, p 141-164, Spring 1968. 24 p, 9 tab, 10 ref.

Descriptors: *Investment, *Engineering, *Economics, *Growth rate, *Costs, Budgeting, Decision making, Computers, Discount rate, Economic evaluation, Marginal utility, Dividends, Value, Time, Optimization, Capital, Data gathering revenue.
Identifiers: *Prospective value, *Opportunity costs, Capital budget, Expectations, Cash flows, Dispursements, Receipts, Incomplete information.

This article analyzes the logic of the capital budget decision in two different situations. In both cases the decision-maker has full knowledge of his current investment opportunities. In one case he also knows his future investment opportunities, while in the other he only knows his expectations about these future opportunities. The article presents a discussion of the capital growth (or discount) rate that should be used in determining whether a marginal increment of investment should be accepted or rejected. The discussion results in the presentation of a capital-budgeting decision criterion called the Maximum Prospective Value Criterion. This criterion is designed to select the investments that have maximum prospective value to the decision-maker, given the information he has at hand. This goal is a general one in public investment decisions including water resource projects. Accordingly, researchers in water investment decision analysis will be interested in this article. (Murphy-Rutgers)
W70-03828

ON SUBSIDIES TO SPEED THE RATE AT WHICH TECHNOLOGIES ARE DEVELOPED,
Office of the Secretary of the Treasury, Washington, D.C.
Laurance C. Rosenberg.
Engineering Economist, Vol 12, No 1, p 1-21, Fall 1966. 21 p, 1 tab, 3 fig, 9 ref.

Descriptors: *Government, *Research and development, *Water desalting, *Technology, Profits, Budgeting, Investment, Financing, Optimization, Correlation, Costs, Prices, Capital cost, Loans, Interest rate.
Identifiers: *Subsidies, *Isotechnology curves, Investment criteria, Social optimum, Rate of return.

The direct financing, by the U S Government, of the technology of water-desalting devices is largely responsible for its rapid development. This and other cases mentioned are areas where government sponsors R and D almost completely and the technology is almost wholly utilized by the private sector. This paper explores an R and D investment decision model with the aim of determining the impact on its variables of some possible subsidy methods that might be used to induce an increased rate of development of specific technologies by private industry. The author constructs a profit-maximizing model for R and D investments, using capital-budgeting theory as its basis. Its implication for subsidy methods of the government are discussed and the impact of these methods, when investment criteria other than the profit maximizing model is used, are mentioned. The importance of government subsidies in water resource development should make this article useful to the water resources investigator. (Murphy-Rutgers)
W70-03830

IS RESOURCE ECONOMICS UNORTHODOX,
Resources for the Future, Inc., Washington, D.C.
Orris C. Herfindahl.
Journal of Soil and Water Conservation, Vol 24, No 1, p 10-11, Jan-Feb 1969. 2 p.

Descriptors: Economics, Political aspects, Natural resources, Resource allocation, Demand, Cost-benefit analysis, Decision making.
Identifiers: *Resource economics.

The author comments on a paper by Sargent in the same journal and argues that the relevant economic and political theory is the same for all applied fields of economies, of which natural resources may be viewed as one. The author contends that the market is the prime resource allocating system for the economy including the natural resource area. However, the fact that the market will not solve all problems is admitted. Often, the pursuit of self-interest will yield less than desirable results. However, it would be wrong to blame the market system for these misallocations. Contrary to Sargent's assertion, demand can be studied and estimated and may possibly suggest procedures that will enable us to reap some of the results generated by market forces. The 'conventional' economist working on resource problems may sometimes err because he does not sufficiently understand the physical and biological relationships involved and because he is not accustomed to working with problems in which benefits and costs external to the decision making unit occupy so prominent a place. The remedy is

not to abandon conventional economics but to learn enough about the problem at hand to apply it. This problem is apparent in the water area where conventional economic theory must be supplemented in many instances by sociological and biological data to improve water resource allocation. (Loeb-Rutgers)
W70-03831

ON INDEPENDENCE POSTULATES CONCERNING CHOICE,
Philippines Univ., Manila.
Jose Encarnacion.
International Economic Review, Vol 10, No 2, p 134-140, June 1969. 7 p, 2 fig, 11 ref.

Descriptors: *Consumption, *Economic evaluation, *Uncertainty, Maximinzation, Probability, Mathematical studies, Decision making, Profits, Prices, Value, Marginal utility.
Identifiers: *Preference ordering, *Independence, *Utility function, Sure-thing principle, Strong independence axiom, Impossibility theorem, Lexicographic ordering.

This paper argues that the independence postulates assumed by Savage, Koopmans, and Arrow are not valid when choice is essentially multidimensional. Specifically, these postulates are violated by certain lexicographic preference orderings which are themselves consistent. The author shows that the 'sure-thing' principle used by Savage presupposes that choice is unidimensional, i.e., representable by a real-valued utility function. Koopmans employs a postulate similar to Savage's but the author shows that his conclusion regarding zones of impatience is not the only possible conclusion and the more correct one would be that the utility function is not real-valued. The binary choice condition used by Arrow is wrong in restricting group choice as a function only of individual choices among the alternatives themselves. Due to the importance of understanding consumer behavior as it applies to water demands this article should be of use to the water researcher interested in the basic theoretical foundations of demand study. (Murphy-Rutgers)
W70-03832

GENERALIZED PRODUCTION FUNCTIONS,
Chicago Univ., Ill.; and State Univ. of New York, Buffalo.
A. Zellner, and N. S. Revankar.
The Review of Economic Studies, Vol 36, No 106, p 241-250, Apr 1969. 10 p, 2 tab, 10 ref, 1 append.

Descriptors: Average costs, Return to scale.
Identifiers: *Generalized production function, Elasticity of substitution, Output, Average cost curves, Labor's share, Maximum likelihood estimate.

In this paper generalized production functions (GPF's) are introduced where the generalization referring to what is assumed about not only the elasticity of substitution but also the behavior of the returns to scale. That is, given a neo-classical production function with a given elasticity of substitution (constant or variable), it is shown how this function can be transformed to yield a neo-classical GPF with the same elasticity of substitution and with the returns to scale variable and satisfying a preassigned relationship to the output level. For example, a GPF may have a constant elasticity of substitution and returns to scale which diminish in a preassigned fashion with the level of output. This contrasts with many current production functions used in applied studies which assume the same returns to scale at all levels of output. Since returns to scale may be different at different scales of operation, GPF may be useful in analyzing data relating to production. Production functions are often estimated in the water research area and as such, the GPF analysis may prove to be applicable to water problems. (Loeb-Rutgers)
W70-03833

A COST MODEL FOR COASTAL SHIPPING, A NORWEGIAN EXAMPLE,
Institute of Transport Economy, Oslo (Norway).
B. Foss.
Journal of Transport Economics and Policy, Vol 3, No 2, p 195-221, May 1969. 27 p, 4 fig, 5 tab.

Descriptors: Ships, Costs, Competition, Return, Fuels, Oil, Maintenance, Claims, Insurance, Capital costs, Indirect costs, Investment.
Identifiers: *Cost model, *Coastal shipping, Air service, Road service, Passenger ships, Cargo ships, Cargo handling costs, Port dues.

The sea has always been a natural route for communications for Norway. However, the importance of sea transport is gradually being eroded. Extensive road building in the coastal districts is enabling bus service to replace the shorter shipping routes, while the longer ones are threatened by competition from the air. Coastal shipping includes scheduled services, ferries and tramp traders. This article analyzes the economics of the scheduled shipping services and develops cost-performance relationships for both construction and operating costs of modern ships. It also considers how far sea transport can hold its own against road and air competition. This discussion will be relevant to water areas such as the Great Lakes as well as the coastal United States. (Loeb-Rutgers)
W70-03834

THE IMPACT OF INDUSTRIAL LINKAGES ON GEOGRAPHIC ASSOCIATION,
North Carolina Univ., Chapel Hill.
Charles E. Richter.
Journal of Regional Science, Vol 9, No 1, p 19-28, Apr 1969. 10 p, 1 tab, 17 ref.

Descriptors: Employment, Correlation analysis, Statistical methods.
Identifiers: *Industrial linkages, *Geographical association, External economics, Industrial location, Coefficient of correlation.

The external economies associated with industrial linkages have frequently been cited as possible causes of economic agglomeration and the uneven geographic distribution of economic activities. It is often asserted that industries locate near their principal markets of sources of materials because high initial transport rates usually discourage intermediate locations. Also advantages in communications encourage important buyers and sellers to locate in geographic proximity. Nevertheless, because of the lack of data and the difficulty of separating out the linkage effect on industrial location, no studies have effectively measured the importance that industrial linkages may have on geographic association between industries. The purpose of this paper is twofold: (1) a new and better measure of geographic association is developed, and (2) the measurement is used to evaluate the importance of linkages on the locations of manufacturing activities. An extension of the topic of this paper might provide insights in the problem of industrial location and its relation to water supply and conditions. (Loeb-Rutgers)
W70-03835

THE DYNAMIC PROGRAMMING APPROACH TO WATER-RESOURCES DEVELOPMENT,
California Univ., Los Angeles.
Warren A. Hall, and Nathan Buras.
Journal of Geophysical Research, Vol 66, No 2, p 517-520, Feb 1961. 4 p, 11 ref.

Descriptors: *Economics, *Optimization, *Water resource development, *Dynamic programming, Benefits, Water resource allocation, Mathematical studies, Rivers, Multipurpose projects, River development, Water supply, Prices, Reservoirs, Computers, Irrigation, Flood control.
Identifiers: *Economic returns, Viable alternatives.

The author blames the present poor state of affairs in river development to the inability of those responsible to consider the large numbers of alternatives with precision. He proposes dynamic programming as a way in which calculations can be reduced to a form which is readily handled by a computer in a relatively short time and one in which optimum policy is computed for every possible level of resource development. In this paper dynamic programming is applied to the optimizing process to permit determination of the 'optimum' policy over a very broad range of alternatives. The solution arrived at provides the optimum allocation of the water resource. The author states that this method may be used on all tractable portions of the individual problems in order to increase the economic returns. (Murphy-Rutgers)
W70-03836

SOCIOECONOMIC STATUS: A RE-EXAMINATION OF ITS DIMENSIONS,
Columbia Univ., New York.
Jerome B. Gordon.
The Journal of Human Resources, Vol 4, No 3, p 343-359, Summer 1969. 17 p, 7 tab.

Descriptors: Regression analysis, Welfare, Costs, Performance, Age, Income, Employment, Labor supply.
Identifiers: *Socioeconomic status, Cobb-Douglas production function, Social welfare, Intensity of skill preparation, Educational attainment, Census SES score, Duncan SES score, GED/SVP code.

It is the author's contention that social scientists are going to be hard put to develop adequate measures of effectiveness or criteria for choosing amongst alternative programs dealing with maximizing social welfare and well-being, or minimizing the costs associated with their delivery. Criteria of choice or measures of effectiveness must be transformations of measures of performance, not the measures of performance themselves. Although one cannot obtain ideal measures of effectiveness, one is not prevented from developing and applying approximate measures. The purpose of this paper is to present some empirical work in the direction of devising a new index of socioeconomic status and its impact on weighting the components of such an index of socioeconomic status. Multiple regression analysis is used to develop a Cobb-Douglas production function for estimating socioeconomic status. Socioeconomic variables have proven to be significant in studies pertaining to the demand for outdoor recreation facilities and other water uses. As such, this article might prove helpful in further studies pertaining to this section of water analysis. (Loeb-Rutgers)
W70-03837

THE OPTIMALITY OF LOCAL SUBSIDIES IN REGIONAL DEVELOPMENT PROGRAMS,
West Virginia Univ., Morgantown.
Carl W. Hale.
The Quarterly Review of Economics and Business, Vol 9, No 3, p 35-50, Autumn 1969. 16 p.

Descriptors: *Optimization, *Regional analysis, *Economics, Interest rate, Taxes, Marginal cost, Financing, Capital investment, Government supports.
Identifiers: *Local subsidies, Unemployment, Minimum wage, Subsidization, Rate of discount.

The concept of local subsidies to private industry is examined. The author wishes to examine three assumptions: (1) that such subsidies act as a foil to institutional impediments to market adjustments; (2) that the subsidies actually attract new firms or branch plants to the community offering; and (3) that no national or regional repercussions of a serious nature result from such practices. The applicability of benefit-cost analysis in attempting to measure the rate of return of such subsidies, is also examined. The use of regional economic analysis in water development studies along with the applicability of the benefit-cost techniques to water resources make this article of interest to the water resource planner. The author shows that optimal

decisions made with regard to regional development programs cannot be made at the community level through the unrestricted use of local subsidies. (Murphy-Rutgers)
W70-03838

PRODUCTION, CONSUMPTION, AND EXTERNALITIES,
Resources for the Future, Inc., Washington, D.C.
R. V. Ayres, and A. V. Kneese.
American Economic Review, Vol LIX, No 3, p 282-297, June 1969. 16 p, 1 fig, 1 tab, 31 ref.

Descriptors: *Economic analysis, *Industrial production, Equilibrium, Pollution, Input-output analysis, Inventory, Natural resources, Water resource development, Taxes, Investment, Transportation, Sewage disposal, River flow, Wastes, Streams, Public health.
Identifiers: *Water residuals, *Production, *Consumption, *Welfare economics, *Externalities.

This article proposes that the externalities associated with the disposal of residuals resulting from the consumption and production processes have an economic significance which increases with economic development. Consequently, the ability of the ambient environment to receive and assimilate them in an important natural resource of increasing value. Such externalities cannot be properly dealt with by isolating environmental media such as water. Restrictions such as taxes are essential in an environmental quality management program, but must be used in conjunction with public investment programs, transportation systems, sewage disposal and river flow regulations. To attain this end, this article presents a model designed to develop improved measures of external costs and systematic methods of forecasting emissions of external-cost producing residuals, the technical and economic tradeoffs between them and the effects of the recycle on environmental quality. Due to its direct application to water this model has important implications for water research methods dealing with evaluations of water pollution control programs. (Murphy-Rutgers)
W70-03843

INSTITUTIONAL FACTORS AFFECTING LAND AND WATER DEVELOPMENT, LOWER RIO GRANDE VALLEY, TEXAS,
Texas A and M Univ., College Station.
Warren L. Trock.
Water Resources Research, Vol 5, No 6, p 1364-1366, Dec 1969. 3 p, 1 ref. OWRR Project No B-025-TEX.

Descriptors: *Water resources development, *Institutional constraints, *Water law, *Water rights, *Rio Grande, Land management, Water management (Applied), Political constraints.
Identifiers: Lower Rio Grande Valley (Tex).

Among the many institutional factors that complicate land and water development in the lower Rio Grande valley are (1) uncertainties in water rights, (2) a proliferation of special districts, (3) inappropriate water management policies among districts, and (4) numerous governmental entities involved in planning and administering water resources. It is recommended that the people of the valley urge and facilitate an early adjudication of rights. Improvements in irrigation and drainage could be achieved by reorganizing the special districts. A master district for the three-county are may be a logical alternative to the many districts that now exist. Rehabilitation of irrigation systems, including installation of water meters, will contribute to the management of water supplies. (Knapp-USGS)
W70-03865

USES OF MATHEMATICAL MODELS IN WATER QUALITY CONTROL STUDIES: CHAPTER IV,
Northeastern Univ., Boston, Mass. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05B.
W70-03934

COST, PRECISION, AND VALUE RELATIONSHIPS OF DATA COLLECTION AND DESIGN ACTIVITIES IN WATER DEVELOPMENT PLANNING,
California Univ., Berkeley. Hydraulic Lab.
For primary bibliographic entry see Field 04B.
W70-03938

STRATEGY FOR MICHIGAN WATER RESOURCES MANAGEMENT: A SYSTEMS APPROACH,
Technology Planning Center, Inc., Ann Arbor, Mich.
James C. Kellogg.
Technology Planning Center, Inc, Ann Arbor, Mich, 1966. 87 p, 7 fig, 10 ref, 3 append.

Descriptors: *Water resources development, *Systems analysis, *Models, *Michigan, *Decision making, *Water demand, Water supply, Interstate, Technology, Programs, Costs, Benefits.

The study presented a strategy for optimum management of Michigan State Water Management. Using a systems analysis approach the strategy was developed as an outline for a Comprehensive Master Plan (CMP). The outline was divided into four steps: (a) the roles and responsibilities of Michigan State in water management were defined as either regional, multi-state, inter-regional, interstate or intrastate; (b) elements of water resource management, i.e., demands for water resources, water resource supply, technology that could be applied to the water resources problem, and the management capabilities available, were defined; (c) a Comprehensive Master Plan model was established for Michigan water resource objectives; and (d) alternative programs were presented, providing as much information as possible on their costs and benefits to those who make state water resource decisions. (Thiuri-Cornell)
W70-03944

DESIGN AND COST OF ION-EXCHANGE SOFTENING FOR A 50-MGD SEA-WATER EVAPORATION PLANT,
California Univ., Berkeley. Sea Water Conversion Lab.
For primary bibliographic entry see Field 03A.
W70-03945

BIOSTIMULATION AND TOXICITY CRITERIA AND APPLICATIONS IN DESIGN--PRESENT PRACTICE AND FUTURE POSSIBILITIES,
Engineering-Science, Inc., Oakland, Calif.
Philip N. Storrs.
Proceedings of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ, Berkeley, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Ore, Pac Northwest Water Lab, p 222-226.

Descriptors: *Eutrophication, *Toxicity, *Water quality, *Design criteria, *Planning, *Forecasting, Analytical techniques, Physiological ecology, Minnesota, Bioassays, Growth stages, California, Benthos, Nutrients, Agricultural wastes, Algae, Water pollution effects, Plankton, Municipal wastes, Industrial wastes, Fish.
Identifiers: *Biostimulation, *Design applications, *Water quality criteria, Growth response, National Water Quality Lab, Duluth (Minn), University of California, Berkeley (Calif), Community structure, San Francisco Bay-Delta Program, Relative toxicity, Species diversity indices, San Francisco Bay, Environmental stresses, Relative biostimulant content, Median lethal tolerance limits.

Problems of water quality management are becoming increasingly complex due to constantly changing criteria. Numbers of criteria increase as does possibility of expressing them quantitatively. The problem is also complicated by increasing diversity of water uses. Current research efforts in biotoxicity and biostimulation are directed toward understanding of mechanisms involved, and developing or improving control methods. That bioassays of toxicity suffer from defects is acknowledged and attempts to circumvent these deficiencies have included assessment of various sublethal organismic responses, development of longer tests over total life history of various organisms, and determination of effects on structure of biological communities. Recent studies have introduced the concept of Relative Toxicity (RT), defined as volume flow rate of a discharge divided by its 48-hour median lethal tolerance limit, developed by bioassays. Analogizing with studies of biotoxicity suggests a program of biostimulation study in specific receiving waters, which involves identification of potential biostimulant sources; bioassays of growth of indigenous algae under conditions simulating environment; development of parameter, Relative Biostimulant Content (RBC), analogous to RT; determining in situ growth and biomass of algal populations; sampling and calculating RBC of receiving waters; determining relationship between RBC and population changes. (See Vol 3, No 7, Field 5C, entry W70-02775). (Eichhorn-Wisconsin)
W70-03982

THE WATERSHED AS AN ENTITY FOR PLANNING,
Tennessee Valley Authority, Knoxville. Div. of Agricultural Relations.
Fletcher E. Riggs.
In: Economics of Watershed Planning, p 59-67, Iowa State University Press, Ames, 1961. 9 p, 1 fig.

Descriptors: *Watersheds, *Planning, Water resources, Tennessee River, River basins, Drainage, Benefits, Costs, Flood control.
Identifiers: *Watershed planning, Regional economic development, Physical characteristic, Watershed problems.

Watershed planning has been primarily concerned with narrow purposes of land and water resources development. In a few instances these objectives have been broader. The Tennessee River watershed has provided the geographic context for a broad program of regional economic development. However, the focus in this paper is on the usefulness of the watershed in planning for the development of land and water resources. The author discusses the physical characteristics of the watershed, watershed problems, and the entity for land and water resources planning. The author concludes that the form of organization for basin-wide planning and for unification of activities in the watershed should be of the river basin type. (See Vol 2, No 14, Field 6B, entry W69-05718). (Loeb-Rutgers)
W70-03987

COMMENT ON, 'THE WATERSHED AS AN ENTITY FOR PLANNING',
Kentucky Univ., Lexington.
John C. Redman.
In: Economics of Watershed Planning, p 68-69, Iowa State University Press, Ames, 1961. 2 p.

Descriptors: *Watersheds, *Planning, Flood control, Costs, Benefits, Size.
Identifiers: Optimum size, Public Law 566.

The question of determining the optimum size watershed is brought up by the author. The author further suggests the examination of the hypothesis that as a watershed becomes larger, it loses (or gains) some claim as the appropriate entity for planning. As watersheds increase in size, social, political, and economic institutions may become more important. If so, more concern should be expressed for other entities, such as a trade or market area. Watershed plans must be coordinated with market plans; often they must be planned simultaneously. Such an arrangement brings together a

group, with similar backgrounds and problems, who have common goals. The whole community should understand the proposal if the project is to be effective. The author suggests that Riggs should have mentioned the influence of purpose and the level of desired flood protection. Like Riggs, the author favors a river basin type of development but only under special conditions. Because of organizational problems, the author is inclined to think that the small watershed has more to contribute than Riggs had indicated. (See Vol 2, No 14, Field 6B, entry W69-05718). (Loeb-Rutgers)
W70-03988

COMMENT ON, 'MESHING WATERSHED DEVELOPMENT WITH RIVER BASIN DEVELOPMENT',
Michigan Univ., Ann Arbor.
Lyle E. Craine.
Economics of Watershed Planning, p 84-86, Iowa State University Press, Ames, 1961. 3 p.

Descriptors: *Watersheds, Planning, River basin, Cost-benefit analysis.
Identifiers: Guiding ideas, Waterservices, Water production planning, Meshing.

The author suggests several specific concepts which may provide guides in designing relationships between watershed development, river basin development, and planning. First, the integrity of the drainage basin as a development unit is inviolate only if the basin is viewed as a production facility for water services. Second, the problem is to determine the extent and methods of articulating water production planning with comprehensive planning, rather than to force one to absorb the other. Third, the extent and method of articulation will differ in different situations, and a major determinant will be the expressed need that motivates a drainage basin development. The author then postulates several types of situations. Fourth, the problem of meshing watershed and river basin development, like that of relating water development to comprehensive planning, also calls more for articulation than for integration. Fifth, the concepts of benefit-cost analysis must be extended beyond the calculus of efficiency. (See Vol 2, No 14, Field 6B, entry W67-05718). (Loeb-Rutgers)
W70-03989

SURVEYS OF ECONOMIC THEORY, RESOURCE ALLOCATION, VOLUME III.

London, England, Macmillan and Co Limited, 1966. 207 p.

Descriptors: *Resource allocation, Economics, Decision making, Operations research, Cost-benefit analysis.
Identifiers: *Economic theory, Linear theory, Household behavior.

The surveys printed within this volume have been produced by the American Economic Association and the Royal Economic Society. The purpose of such a volume is to make the literature pertaining to the advances in theories in economics more reasily available to students, research-workers and teachers. The topics included in this volume are: theories of decision making, operations research, linear theory, research on household behavior, and cost benefit analysis. These subjects have been found to be useful tools in the water area and this book provides the researcher with a useful summary and bibliography in the areas examined. (See also W70-03991 thru W70-03994). (Loeb-Rutgers)
W70-03990

THEORIES OF DECISION-MAKING IN ECONOMICS AND BEHAVIORAL SCIENCE,
Carnegie Inst. of Tech., Pittsburgh, Pa.
Herbert A. Simon.
Surveys of Economic Theory, Resource Allocation, Vol III, p 1-28, Macmillan, London, England, 1966. 28 p, 71 ref.

Descriptors: *Decision making, *Economics, *Psychological aspects, Behavior, Probability, Computers, Risks.
Identifiers: Behavioral science, Utility, Empirical studies, Normative applications, Binary choice experiment, Probabilistic preferences, Satisfying, Maximizing, Business behavior, Game theory, Bargaining, Expectations.

The role of psychology in the realm of economics is discussed. As the complexity of man's environment increases we need to know more and more about the mechanisms and processes that economic man uses to relate himself to that environment and achieve his goals. How close we wish to interweave economics with psychology depends on the range of questions we wish to answer and our assessment of how far we may trust the assumptions of static equilibrium as approximations. In both the theory of utility and its application to choice under uncertainty (as well as in consumer saving and spending) and in the macroeconomic sector (where one attempts to understand the process of making business decisions) notions of adaptive and satisfying behavior are challenging the classical picture of the maximizing entrepreneurs. Psychologists and economists have been applying a wide variety of approaches to the study of the formation of expectations. The author suggests that as economics finds it more and more necessary to understand and explain disequilibrium as well as equilibrium, it will find an increasing use for the digital computer for communication with psychology and sociology. The ideas of expectations and uncertainty play an important role in water demand and investment decisions. This article is relevant to the water area by reviewing the multidiscipline activity in areas traditionally considered economic in nature. (See W70-03990) (Loeb-Rutgers)
W70-03991

RESEARCH ON HOUSEHOLD BEHAVIOR,
Illinois Univ., Urbana.
Robert Ferber.
Surveys of Economic Theory, Resource Allocation, Vol III, p 114-154, Macmillan, London, England, 1966. 41 p, 170 ref.

Descriptors: Income analysis, Economics, Income, Expenditures, Decision making.
Identifiers: *Household behavior, Spending, Saving, Absolute income hypothesis, Relative income hypothesis, Socioeconomic characteristic, Expectations, Asset holdings.

The purpose of this paper is to survey the main empirical research of recent years on household behavior. Although the emphasis is on empirical work the principal theoretical developments are also reviewed. The article relates to consumer behavior at the microeconomic level. Although various parts of the discussion present the problems of aggregation and of macroeconomic relations, comprehensive coverage of these areas is outside the present article. Furthermore, the emphasis is on spending and saving behavior rather than on the income or other economic or non-economic behavior aspects of the consumer. At the same time this article transcends the usual boundaries of economics, to cover the growing importance of other disciplines in this area, particularly marketing, sociology and psychology. This article would be relevant to the water area for studies analyzing consumer demand for water. (See W70-03990). (Loeb-Rutgers)
W70-03994

WATER RESOURCES MANAGEMENT AND PUBLIC POLICY.
Washington Univ., Seattle.

Edited by Thomas H. Campbell and Robert O. Sylvester. Seattle, University of Washington Press, 1968. 253 p.

Descriptors: *Water quality, *Water resource development, Population, Pollution, Water supply, Economics, Waste disposal, Natural resources, Regional analysis, Fisheries, Management, Government, Water transfer, Cost-benefit analysis, Surface water, Economic efficiency, Economic feasibility, Legal aspects, Model studies, Hydrology, Aquifer, Lakes, Industrial wastes, Water law, Water resource planning.
Identifiers: Agricultural production, Land development, Public policy.

This book is an attempt to outline, for laymen, academicians, legislators, and the public, many of the relevant issues that should be considered in the management of water resources. It is based on papers prepared by the numerous contributors on the problems involved in water quality and water supply. Project analysis and agricultural demand for water in the West is discussed as well as the development of surface waters of California's Central Valley; using benefits and economic efficiency as the yardstick. The concept of benefit-cost is then examined in detail. Several papers emphasize the need for research and tell of some results on the Columbia River and the Pullman-Moscow aquifer. The methodology of establishing water-quality standards is examined, the economics of the problem discussed and an empirical example is provided. The techniques of receiving-water monitoring are presented, along with the industrial views about pollution. (See also W70-03996 thru W70-04000). (Murphy-Rutgers)
W70-03995

WATER FOR WESTERN FEDERAL IRRIGATION PROJECTS,
Washington State Univ., Pullman.
For primary bibliographic entry see Field 03F.
W70-03996

WATER RESOURCE DEVELOPMENT IN CALIFORNIA: THE COMPARATIVE EFFICIENCY OF LOCAL, STATE AND FEDERAL AGENCIES,
California Univ., Berkeley.
For primary bibliographic entry see Field 04A.
W70-03997

THE ECONOMICS OF AGRICULTURAL WATER USE,
Washington Univ., Seattle.
Gardner Brown.
Water Resources Management and Public Policy, Seattle, University of Washington Press, p 30-43, 1968. 14 p, 15 ref.

Descriptors: *Irrigation, Economic analysis, *Optimization, Cost-benefit analysis, Pricing, Government, Demand, Water supply, Water transfer, Economic efficiency, Bonds, Government supports, Social aspects, Water law, Marginal cost, Profits, Economic evaluation.
Identifiers: *Water agencies, *Externalities.

Water is another input or factor of production which the farmer, acting as the firm, employs to produce an output or combination of outputs. Some examples of the application of economic analysis are given, but the economists' assumptions underlying the analysis are not always fulfilled. An account of these complications and the steps which are being taken to overcome them is presented in the paper. The author then examines the policies of the Bureau of Reclamation as well as their consequences from the viewpoint of economic theory. A brief discription of the pricing policies associated with the California State Water Project is then provided and a comparison made between the practices of the Bureau of Reclamation and the California Department of Water Resources. The author concludes with an evaluation of the need for careful and imaginative economic analysis to estimate the magnitudes and distribution of costs and benefits associated with competing water policy choices. (See W70-03995) (Murphy-Rutgers)
W70-03998

BENEFIT-COST ANALYSIS: A CRITERION FOR SOCIAL INVESTMENT,
Stanford Univ., Calif.
Robert C. Lind.
Water Resources Management and Public Policy, Seattle, University of Washington Press, p 44-64, 1968. 21 p, 9 ref.

Descriptors: *Cost-benefit analysis, *Economic evaluation, *Social aspects, *Water resource development, Social welfare, Economic efficiency, Income, Regional analysis, Prices, Profits, Capital, Decision making, Discount rate, Economics, Irrigation, Government, Consumption, Interest rate, Flood control, Demand.
Identifiers: *Social investment, Time preference.

The general procedure of benefit-cost analysis is outlined and the rationale behind the procedure is explained. The desired measure of benefits and costs is discussed, as are the conditions under which market prices can be used in measuring benefits and costs. The relationship between the benefit-cost criterion and economic efficiency is brought out and the relation of the benefit-cost to profitability criterion is discussed. The special characteristics of social investment are then developed as are the difficulties that these characteristics create for the measurement of benefits and costs. The problem of incorporating risk in the decision rule is discussed in connection with the social rate of discount. The last section presents conditions under which benefit-cost analysis may be applied and points out several cases where market imperfections may complicate the problem of measuring costs and benefits. As an area of social investment where benefit-cost analysis is important, water resource development depends on the application of these principles and the author presents several examples of their application in the water area. (See W70-03995) (Murphy-Rutgers)
W70-03999

ECONOMIC ANALYSIS IN WATER QUALITY MANAGEMENT,
Washington Univ., Seattle.
James A. Crutchfield.
Water Resources Management and Public Policy, Seattle, University of Washington Press, p 129-138, 1968. 10 p.

Descriptors: *Waste disposal, *Economic analysis, *Cost minimization, Statistics, Water quality, Management, Economic efficiency, Demand, Water supply, Pollution, Costs, Benefits, Risks, Government, Decision making, Economic feasibility.
Identifiers: *Private costs, *Social costs, Uncertainty.

The principals underlying optimal and suboptimal systems of water-quality management is discussed. Examination is also conducted on the effects of the divergence of private and social costs and benefits in water use as well as the complications introduced by technological economies of scale in waste disposal. The contribution of economic analysis to water quality management in the handling of risk and uncertainty is discussed along with the problem of the extent to which the uses impaired by water-quality degradation are of the types most difficult to measure in economic terms. These difficulties, coupled with the wide areas of incomplete knowledge of highly variable physical parameters, suggest that water-quality management must in practice be limited to suboptimal systems designed to minimize aggregate waste-disposal costs subject to one or more constraints. (See W70-03995) (Murphy-Rutgers)
W70-04000

AN ACTIVITY ANALYSIS OF NON-STRUCTURAL PLAIN MANAGEMENT ALTERNATIVES: CHAPTER IV,
Wisconsin Univ., Madison. Water Resources Center.
For primary bibliographic entry see Field 06F.
W70-04003

NATIONAL RIVERS AND HARBORS CONGRESS SUPPORTS A COMPREHENSIVE WATER RESOURCES DEVELOPMENT PROGRAM,
For primary bibliographic entry see Field 06E.
W70-04043

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

WATER DEVELOPMENT FUND.

Mo Ann Stat secs 256.280 thru 256.370 (Supp 1970).

Descriptors: *Missouri, *Water resources development, *Water allocation (Policy), *Water management (Applied), Municipal water, Legal aspects, Legislation, Industrial water, Water storage, Water supply, Water resources, Reservoirs, Public utilities, Federal government, Administrative agencies, Water distribution (Applied), Water conservation, Water utilization, Project planning, Local governments.

The Missouri Water Development Fund is created for the purpose of financing the storage of the municipal and industrial water supply in public works projects and in works constructed with federal assistance. The Water Resources Board is responsible for proper distribution and allocation of the state-owned water supply. The Water Resources Board may sell or sublet water from storage. The Board may, with approval of the General Assembly, sell or sublet water from the municipal and industrial water supply to special-benefit users at cost. The Water Resources Board, acting on behalf of the state, must protect public interests in federal reservoirs. (Powell-Florida)
W70-03770

MISSOURI FEDERAL WATER PROJECTS RECREATION FUND.
Mo Ann Stat secs 258.500 thru 258.540 (Supp 1970).

Descriptors: *Missouri, *Conservation, *Recreation, *Water resources development, Legal aspects, Legislation, Federal government, State governments, Natural resources, Project purposes, Projects, Water conservation, Water resources, Water utilization, Appropriation, Wildlife conservation, Fish conservation, Benefits, Federal project policy, Reservoirs.

The Missouri Federal Water Projects Recreation Fund is created. Money is appropriated from the fund for purposes of paying non-federal costs associated with the enhancement of recreation and fish and wildlife benefits on federal reservoir lands and waters. (Powell-Florida)
W70-03771

THE WATER SUPPLY SYSTEM UP TO A.D. 2001,
Manchester Business School (England).
Douglas Wood.
Journal of Industrial Economics, Vol XVIII, No 1, p 64-75, Nov 1969. 12 p, 3 tab.

Descriptors: *Water supply, *Water demand, *Costs, *Cost minimization, *Economic feasibility, *Demand, *Joint costs, Nuclear energy, Technology, Cost-benefit analysis, Electrical power costs, Economics, Water purification, Reservoirs, Water distribution, Pricing.
Identifiers: *Barrage, *Joint production, *Opportunity costs, *Social costs.

The article attempts to deal with the prospective water supply deficit for the year 2000. Although the example used in this study is the English water problem, the techniques and problems studied are of general significance for the water resource planner. The determinants of the domestic, industrial and agricultural demand are explained and estimates made. A number of ways of fulfilling this demand are explained along with their feasibility from a cost-benefit point of view. It appears that, when considering social costs and benefits, a barrage has a clear advantage over any conventional scheme. The problems associated with joint production of electricity and water are studied with special concentration on allocation of costs. The only valid economic technique is to use the opportunity cost of securing an equivalent production from an alternative source. This method of cost allocation is studied and conclusions are reached regarding the most economically feasible method of meeting water demand. (Murphy-Rutgers)
W70-03842

RETURNS TO SCALE AND COST CURVES,
Washington Univ., Seattle.
Lowell Bassett.
The Southern Economic Journal, Vol XXXVI, No 2, p 189-191, Oct 1969. 3 p, 1 fig.

Descriptors: *Returns to scale, *Costs, *Input-output analysis, Economics, Cost minimization, Prices, Average costs, Mathematical studies, Productivity, Economies of scale.
Identifiers: *Production functions, Indifference curves, Homogeneous functions.

The article attempts to clarify some of the confusion about the relationship between returns to scale and per unit economic costs. Increasing returns to scale implies that average cost is decreasing; however, constant returns permit either constant or decreasing per unit costs while the condition of decreasing returns is consistent with increasing, constant or decreasing average costs. Thus, it is shown that knowledge of the slope of the average cost curve is not sufficient justification for saying anything about returns to scale for the general class of production functions. Owing to the importance of production functions and costs analysis in water resource development, this article should prove useful to the water resource planner. (Murphy-Rutgers)
W70-03844

6D. Water Demand

LARGE VOLUME - LONG DISTANCE FRESH WATER TRANSFERRAL AS AN ALTERNATE TO DESALINATION,
Hudson Inst., Croton-on-Hudson, N.Y. Economic Development Studies Section.
Basil Candela, Ronald Dagon, John Karlik, and Robert Panero.
Hudson Institute, Croton-on-Hudson, NY, 1968. 52 p, 22 tab, 6 fig. HI-923/2-P.

Descriptors: *Arid lands, *Southwest U.S., *Water transfer, Desalination, *Mississippi River, Costs, Economic feasibility, Aqueducts, Pumping plants, Reservoirs, Tunnels, Oklahoma, Texas, New Mexico, Arizona, Colorado River Basin, Dams, Water demand, Evaporation.
Identifiers: *Arkansas River.

A preliminary evaluation was made of the transfer of Mississippi and Arkansas River water from 800 to 1600 miles to the southwestern U.S. as an alternative to desalination. The system described would use about 10% of the Mississippi flow transferred by pumping stations, reservoirs, tunnels and aqueducts to Texas, Oklahoma, New Mexico, Arizona, and the lower Colorado River use areas. It is concluded that such water transfer could be done at a cost of 5 to 12 cents per thousand gallons. This is substantially lower than estimated desalination costs of 20 to 30 cents per 1000 gallons plus costs of delivery. The arid areas of the Southwest could be dependably and permanently watered by a transfer system such as proposed for an investment of 5 to 12 billion dollars. The desirability of investing in such a large scale system would be dependent upon whether the Southwest could develop a demand for such a volume of water. (Crouse-Arizona)

W70-03810

THE WATER-RESOURCE COMMUNICATIONS GAP,
William S. Foster.
The American City Vol LXXXIV, No 10, p 83-86, Oct 1969. 4 p, 9 ref.

Descriptors: *Water purification, *Economics, *Pollution, Aeration, Biological treatment, Government supports, Water supply, Water demand, Desalination, Piping, Water storage population, Management, Costs, Farm wastes, Measurement, Computers.
Identifiers: *Mechanical chemical, Agricultural pollution, Metering, Water reuse, Chemical pollution.

The author predicts a huge increase in the amount of water demand in urban areas based on population predictions. He considers various aspects of the prospective problem along with the economic, esthetic, and safety factors. The economic feasibility of desalting sea water is discussed as well as the changes required in above ground storage, piping and metering practices. He stresses the necessity for improved water quality and describes some of the dangers of agricultural pollution. The article concludes with a discussion of the low initial but high operating costs of the mechanical-chemical water purification plants and the necessity of making the public aware of the problem. (Murphy-Rutgers)
W70-03841

THE WATER SUPPLY SYSTEM UP TO A.D. 2001,
Manchester Business School (England).
For primary bibliographic entry see Field 06C.
W70-03842

6E. Water Law and Institutions

THE TIDELANDS CONTROVERSY AND LOUISIANA'S EXPERIENCE IN THE DISPUTE,
J. Gremillion.
In: 1963 Tulane Tidelands Inst, p 77-105, Claitor's Book Store (1963) Baton Rouge, La.

Descriptors: *Louisiana, *Submerged Lands Act, *Tidal waters, *Continental shelf, Federal government, State governments, Coasts, Relative rights, Leases, Judicial decisions, Legislation, Legal aspects, High water mark, Low water mark, Oil fields, Boundary disputes, Gulf of Mexico, California, Texas, Mississippi, Alabama, Florida, Treaties, Littoral.
Identifiers: Tidal lands, Made lands.

This report by the Attorney General of Louisiana examines the history of the tidelands controversy up to May 15, 1962. The controversy is described in chronological sequence beginning with Senate Joint Resolution 208, 75th Congress 1st Sess, which although ultimately defeated, proposed to declare the bed of the sea within three miles of the shore of the United States to be property of the federal government. Both the litigation and legislation involved in the controversy are outlined with emphasis upon the Submerged Land Act of 1953. The report discusses: (1) federal leasing in the contested areas; (2) the placing of lease revenue in escrow by the United States and Louisiana; (3) made-land problems; (4) the effect of the Geneva Convention; (5) equal boundary legislation; and (6) the work of the 1962 Coast Line Committee. A glossary defines: tidelands, littoral state, lands beneath navigable waters, made-lands, coast line, boundaries, continental shelf, inherent sovereignty, paramount rights, baseline, and marine league. Reference is also made to the Norwegian Fisheries Case and to the Outer Continental Shelf Lands Act. Emphasis is placed upon the Louisiana situation. (Marsee-Florida)
W70-03688

SHAPING THE LAW OF WEATHER CONTROL,
V. Ball.
Yale L J, Vol 58, No 2, p 213-244, Jan 1949. 32 p, 131 ref.

Descriptors: *Weather modification, *Legal aspects, *Political aspects, *Artificial precipitation, Cloud seeding, Climatology, Cloud physics, Conservation, Droughts, Federal government, State governments, Meteorology, Rain, Storms, Weather, Water shortage, Water supply, Weather forecasting, Flood control, Hurricanes, Hail, Lightening, Snowfall.

In analyzing the legal problems involved in artificial modification or control of the weather, this article discusses: (1) scientific advances in weather modification and their possible application; (2) storm modification including thunderstorms, hail, lightening, snowstorms and hurricanes; (3) water storage and drought alleviation; (4) prevention of freezing rain, sleet and glaze; (5) cloud and fog dispersal; (6) forest fires; (7) flood control; (8) military uses; (9) classes of legal disputes arising from weather modification; (10) criminal prosecution and similar statutory penalties; (11) tort liability; (12) discovery, proof and causation; (13) government conduct in the area; (14) security restrictions on weather experiments; (15) claims of property in weather phenomena; and (16) water rights. A program for action for solution of the legal problems relating to weather control and experimentation deals with: (1) temporary prevention of irresponsible activity; (2) government-sponsored activity; (3) government authority; (4) government liability and waiver of immunity; and (5) authority to indemnify government contractors for losses incurred by liability for damages. (Marsee-Florida)
W70-03719

MINERAL RIGHTS VERSUS WATER RIGHTS,
Edward W. Clyde.
Nat Res Lawyer, Vol 2, No 4, p 299-328, Nov 1969. 30 p, 99 ref.

Descriptors: *Water management (Applied), *Utah, *Mineralogy, *Preferences (Water rights), Prior appropriation, Dewatering, Mine water, Mine drainage, Mining, Coal mines, Mineral industry, Strip mines, Land subsidence, Prescriptive rights, Hydrologic cycle, Irrigation, Land subsidence, Water rights, Water allocation (Policy), Natural flow doctrine, Competing uses, Equitable apportionment, Overlying proprietor, Water reuse, Water salvage, Water pollution, Legal aspects, Oil, Natural gas.

In a time of increasing technological progress, the law must change to meet the needs of the evolving society. Today, increased individual use by industry of our natural resources is prescribed by the law that has grown out of the needs of our society. The individual must bend to the will, i.e. the law, of the majority. In the area of water use and the mining of coal, oil, and minerals, a balance between the individual's use and the needs of the general public is necessary. An extensive review of case law in the western United States examines the law of the country which balances the rights of the individual versus the individual, the individual versus industry and the individual versus society. The major emphasis is on the mining industry and its use of percolating, ground and surface waters termed therein as the private right to develop land versus private water rights. The right of eminent domain to acquire rights of way to put water to beneficial use is examined. Other problems in the general area of competing uses of water are discussed. (Barnett-Florida)
W70-03735

REGULATION OF FERRY OPERATIONS.
Ohio Rev Code Ann secs 4583.01 thru 4583.17 (Page 1965).

Descriptors: *Ohio, *Boats, *Boating regulations, *Transportation, Legal aspects, Streams, Navigation, Regulation, Navigable waters, Riparian rights, Riparian land, Legislation, State governments, Rates, Permits, Control, Standards, Operation.

Licenses must be procured by individuals who desire to operate and maintain ferries within the state. Persons owning land on both sides of a stream at the proposed location of a ferry have the exclusive right to operate the ferry at that site. Maximum rates for transporting persons and property by ferry are established by the court. Minimum daily service requirements for ferry operation are set forth. Penalties are provided for ferrymen who fail to meet these operation requirements or who charge excessive rates. (Casey-Florida)
W70-03739

DUTIES OF DIRECTOR OF PUBLIC WORKS REGARDING SWAMP LANDS.
Ohio Rev Code Ann sec 155.06 (Page 1969).

Descriptors: *Ohio, *Swamps, *Land tenure, *Real property, Legislation, Wetlands, Surveys, Mapping, State governments, Administrative agencies, Federal government, Legal aspects, Patents, State jurisdiction, Marshes, Maps, Proprietary power.

The Director of Public Works is required to obtain scrip and patents for all lands belonging to the state. The Director must make a record of all swamp, marsh, and overflow lands to which the state has or should have title and attempt to perfect title to such lands which might belong to the state. He is directed to collect for the state all money due from the federal government for lands sold or purchased within the state by the United States or its agents. The Director is to survey all state lands, have plats made and file them with the state auditor, and record the title to such lands in the proper county. The Governor may impose additional duties upon the Director concerning claims against the federal government or lands belonging to the state. (Schram-Florida)
W70-03740

COUNTY FISHING LAKES AND RECREATION GROUNDS.
Tenn Code Ann secs 11-801 thru 11-803 (1956).

Descriptors: *Tennessee, *Recreation, *Lakes, *Recreation facilities, Legislation, Eminent domain, Condemnation, Compensation, Local governments, Construction, Real property, Fishing, Sport fishing, Legal aspects, Wildlife management, Public lands, Public benefits, Damages, Assessments, Payment, Resource development, Area redevelopment.

Any county court may acquire by gift, purchase, or condemnation any natural lakes or lands suitable for the construction of lakes. The county may hold fee simple title to the land and may acquire it under the laws of eminent domain. Before any natural lake or lands adapted for the construction of lakes is condemned, an engineer's plat must be made and filed in the county register. After such filing the county court may acquire the property which shall be dedicated to the public use under the game and fish laws of the state. All compensation and damages for property acquired for these purposes shall be a direct charge upon the general county fund and shall be paid when properly assessed under the laws of eminent domain. (Schram-Florida)
W70-03745

BOUNDARIES (STATE).
Tenn Code Ann secs 4-201 thru 4-207 (1956).

Descriptors: *Tennessee, *Boundaries (Property), *Mississippi River, *Political aspects, State jurisdiction, State governments, Rivers, Tennessee River, Islands, Legal aspects, Interstate rivers.

The boundaries of the state of Tennessee are detailed. The western boundary is the middle of the stream of the Mississippi River. (Schram-Florida)
W70-03747

POWERS UNDER CITY MANAGER CHARTER.
Tenn Code Ann sec 6-1901 (1956).

Descriptors: *Tennessee, *Cities, *Public utilities, *Waste disposal, Legislation, Legal aspects, Financing, Taxes, Condemnation, Regulation, Construction, Bridges, Maintenance, Sewers, Drains, Drainage, Sewage, Streams, Rivers, Structures, Utilities, Public health, Surface drainage, Docks, Permits, Operation and maintenance, Pollution sources.
Identifiers: *Improvements, Viaducts, Franchises, Land acquisition.

Every city will have the following powers relating to water law: (1) to collect taxes for all city purposes; (2) to finance necessary structures and improvements; (3) to acquire by condemnation or otherwise and hold any interest in property; (4) to acquire, construct, maintain, operate or lease any public utility; (5) to grant franchises for public utilities and public services to be furnished the city; (6) to prescribe reasonable regulations governing the maintenance, operation and extension of public utilities; (7) to establish, alter, construct, and maintain public docks, bridges, viaducts, sewers and drains and to regulate the use thereof; (8) to provide for the drainage of all public places; (9) to acquire, construct, regulate and maintain bridges, sewers, structures, works and improvements; (10) to collect and dispose of drainage, sewage, offal, ashes, garbage and refuse by discharging the same into streams and rivers or otherwise, or to license and regulate such collection and disposal; and (11) to define, prohibit, abate, prevent and regulate all things detrimental to the health, comfort, safety or welfare of the citizens. (Keith-Florida)
W70-03749

BRIDGES.

Mo Ann Stat secs 234.100 thru 234.200 (1952), as amended, (Supp 1970).

Descriptors: *Missouri, *Bridges, *Right-of-way, *Financing, Administrative agencies, Government finance, Legislation, Legal aspects, Navigable waters, Streams, Condemnation, Eminent domain, Projects, Local governments, Construction, Maintenance, Assessments, Highways, Civil engineering, Bridge construction.

Any Missouri city adjoining a navigable stream and separated by such stream from a Missouri county and the county court of such county may unite in purchasing a right-of-way over any bridge crossing such stream. The city and county may unite for construction of a proposed bridge across a navigable stream. The financing and assessment of costs incurred by purchasing such rights-of-way are regulated. Condemnation proceedings to secure a public access to such bridge are governed. A toll bridge connecting two counties is permitted when the bridge cannot be built, reconstructed, or maintained at county expense due to the lack of funds or power to raise the funds. The building or reconstruction of a toll bridge to be located wholly within one county is regulated. A toll bridge is part of the Missouri highway system. The Missouri State Highway Commission is authorized to join with the state highway commission of another state in contracting for a toll bridge to connect the two states. (Powell-Florida)
W70-03750

BRIDGES.
Mo Ann Stat secs 234.210 thru 234.350 (1952).

Descriptors: *Missouri, *Bridges, *Local governments, *Bridge construction, Legislation, Easements, Right-of-way, Condemnation, Financing, Real property, Eminent domain, Highways, Administrative agencies, Supervisory control (Power), Construction costs, Loans, Interest, Assessments, Costs, Maintenance costs, Government finance, Tunnels, Tunnel construction.
Identifiers: *Toll bridges.

Any political or civil subdivision of the state may acquire, construct, and operate toll bridges, within or adjacent to its jurisdiction, and over any waters in or forming the boundary of the state. These state agencies may acquire, by purchase or eminent domain, all necessary land, rights-of-way, easements, and materials for constructing, improving, or maintaining toll bridges. The State Highway Commission, when in the best interests of the state, may contribute up to thirty percent of the construction costs of these bridges and may maintain such bridges as a part of the state highway system. Qualifications and procedures for financing the toll bridges are detailed. Cities operating under special charter are authorized to acquire or construct bridges and viaducts and maintain them for the public use. For this purpose lands, easements, rights-of-way, and other property rights may be purchased or acquired by condemnation. First class cities and cities of over one hundred thousand population may construct bridges and tunnels for public use. (Schram-Florida)
W70-03751

TENNESSEE-MISSOURI BRIDGE COMMISSION.

Mo Ann Stat secs 234.360 thru 234.420 (1952).

Descriptors: *Missouri, *Bridge construction, *Interstate compacts, *Interstate commissions, Bridges, Tennessee, Legislation, Financing, Planning, Maintenance, Repairing, Compensation, Condemnation, Supervisory control (Power), Cost repayment, Real property, Maintenance costs, Construction costs, Costs, Bridge construction, Mississippi River, Administrative agencies, Easements.
Identifiers: *Tolls, Toll bridges, Ferries.

The Governor, with the advice and consent of the Senate, will appoint three commissioners to enter into a compact with Tennessee. The Tennessee-Missouri Bridge Commission is created with the following powers and duties: (1) to plan, construct, maintain and operate a bridge across the Mississippi River at or near Caruthersville, Missouri; (2) to purchase, maintain and operate any or all ferries across the Mississippi River within twenty-five miles of the bridge; (3) to contract and acquire property by condemnation or otherwise; (4) to issue bonds for the payment of the costs of the bridge, ferries, and necessary property on the security of the revenues derived from the operation of the bridge and ferries; (5) to establish and charge tolls for transit over such bridge and ferries; and (6) to perform all other necessary and incidental functions. Toll rates will be charged to provide funds sufficient to pay for maintenance, repairs, and operation of the bridge, and to pay the principal and interest on outstanding bonds. The administrative composition of the Commission is provided for. Upon the retirement of all bonds and the conveyance of title to the bridge to the states of Missouri and Tennessee, the Commission will be dissolved. (Schram-Florida)
W70-03752

MISSOURI--ILLINOIS BRIDGE COMMISSION.

Mo Ann Stat secs 234.500 thru 234.570 (Supp 1970).

Descriptors: *Missouri, *Interstate commissions, *Supervisory control (Power), *Bridge construction, Administrative agencies, Federal government, State governments, Structures, Financing, Mississippi River, Real property, Condemnation, Easements, Legislation, Regulation, Planning, Illinois, Operation and maintenance, Interstate compacts, Interstate rivers, Bridges.
Identifiers: Penalties (Civil), Ferries, Tolls.

The states of Missouri and Illinois establish by compact an Illinois-Missouri Bridge Commission to plan, construct and maintain a bridge across the Mississippi River between the two states. The Commission may purchase, maintain, and operate all ferries within fifteen miles of the site selected for the bridge. It may acquire real property necessary for construction of the bridge. It may issue bonds to finance the bridge and charge tolls for transit over the bridge. When the bonds have been retired, each state shall own that part of the bridge within its borders, and thereafter the bridge shall be toll free. The organization of the Commission is described. The compact is to be submitted to the United States Congress for approval. The Commission shall be dissolved upon retirement of all bonds and conveyance of title to the bridge to the two states. (Duss-Florida)
W70-03753

MISSOURI-ILLINOIS-JEFFERSON-MONROE BRIDGE COMMISSION.

Mo Ann Stat secs 234.580 thru 234.650 (Supp 1970).

Descriptors: *Missouri, *Interstate compacts, *Bridge construction, *Interstate commissions, Illinois, Mississippi River, Interstate rivers, Construction, Maintenance, Planning, Financing, Bridges, Costs, Contracts, Condemnation, Structures, Regulation, Easements, Administrative agencies, Legislation, Legal aspects, Supervisory control (Power), Operation and maintenance.
Identifiers: Ferries, Tolls, Bonds.

The Governor, with the advice and consent of the Senate, will appoint three commissioners to enter into a compact with Illinois. The Missouri-Illinois-Jefferson-Monroe Bridge Commission is created with following powers and duties: (1) to plan, construct, maintain and operate a bridge across the Mississippi River at or near Crystal City, Missouri; (2) to purchase, maintain, and operate any or all ferries across the Mississippi River within twenty-five miles of the bridge; (3) to contract and acquire property by condemnation or otherwise; (4) to issue bonds for the payment of the costs of the bridge, ferries and necessary property on the security of the revenues derived from the operation of the bridge and ferries; (5) to establish and charge tolls for transit over such bridge and ferries; and (6) to perform all other necessary and incidental functions. Toll rates will be charged to provide funds sufficient to pay for maintenance, repairs and operation of the bridge and to pay the principal and interest on outstanding bonds. The administrative composition of the Commission is provided for. Upon the retirement of all bonds and the conveyance of title to the bridge to the states of Missouri and Illinois, the Commission will be dissolved. (Keith-Florida)
W70-03754

FERRIES AND WHARVES.

Mo Ann Stat secs 237.010 thru 237.240 (1952).

Descriptors: *Missouri, *Docks, *Boats, *Permits, Boating regulations, Rates, Legislation, Boating, Cities, Local governments, Ships, Legal aspects, Transportation, Leases.
Identifiers: *Ferries, *Licenses.

A license is required in order to keep a commercial ferry. Procedures for the application, issuance, continuation and revocation of ferry licenses are provided. Ferriage rates are fixed by the county court. Any city, town, or other municipal corporation may lease to any owner of boats, steamboats, or vessels any portion of the city or town wharf or landing for the purpose of maintaining wharf boats to accommodate steamboats and merchants in the reception and discharge of freights. (Powell-Florida)
W70-03755

ISLANDS AND ABANDONED RIVER BEDS.

Mo Ann Stat secs 241.290 thru 241.340 (1952).

Descriptors: *Missouri, *Islands, *Beds, *Ownership of beds, Dry beds, Local governments, Legislation, Lake beds, River beds, Navigable waters, Streambeds, Meanders, Compensation, Boundaries (Property), Surveys, Land reclamation, Public lands, Swamps, Mapping, Real property, Overflow, Federal reclamation law, Legal aspects, Reclamation, Land forming.
Identifiers: Counties.

Unless otherwise appropriated, all state lands formed by the recession of waters from old lake and river beds or by the formation of islands in the navigable waters of the state are transferred to the respective counties in which they are located. These lands are to be held for school purposes. All state lands hereafter found in the above manner shall also be transferred to the counties for school purposes. All counties in which such lands are situated may survey and sell them in the same manner as reclaimed swamp lands. The proceeds of such sales shall become a part of the swamp land school funds of the counties. In surveying these lands, the surveyor shall: (1) connect the survey with some United States survey corner; (2) meander islands and such beds as may abut on a navigable river or lake; and (3) subdivide such lands into section and quarter sections. (Schram-Florida)
W70-03759

TOWN OF PALM BEACH V CARTER (PROHIBITION OF SURFING WITHIN TOWN LIMITS FOUND CONSTITUTIONAL).

229 So 2d 3-5 (4th DCA Fla 1969).

Descriptors: *Recreation, *Surf-boarding, *Water sports, *Beaches, Attitudes, Swimming, Public health, Safety, Local governments, Surf, Shores, Legislation, Judicial decisions, Legal aspects, Cities, Motivation.

The defendant was convicted in municipal court for violating an ordinance prohibiting operation of a surfboard adjacent to any beach within the town limits. The circuit court reversed the conviction, declaring the ordinance to be an unconstitutional exercise of the municipality's police power. The district court reinstated the municipal court's conviction. The district court stated that the constitutionality of the ordinance depended upon whether or not it had a natural relation to the health, morals, safety, or general welfare of the public. Finding that the ordinance was designed to make the public beaches safe and was prompted by the town's decision that surfing had become hazardous to bathers, the court concluded that the ordinance was a reasonable exercise of the police power. (Schram-Florida)
W70-03764

UNITED STATES V 967.905 ACRES OF LAND (CONDEMNEES DEMAND COMPENSATION FOR BARGES ON LAKE SURROUNDED BY CONDEMNED LAND).
305 F Supp 83-93 (D Minn 1969).

Descriptors: *Minnesota, *Eminent domain, *Condemnation, *Compensation, State governments, Federal government, Federal jurisdiction, Federal reservations, Public lands, Real property, Condemnation value, Fishing, Lake shores, Lakes, Legislation, Foreign countries, Conservation, Judicial decisions, Legal aspects, Boats, State jurisdiction.
Identifiers: Canada.

The United States took certain land by eminent domain to establish a wilderness area. The condemnees contended that they should be compensated for three cabin barges which had been used in the operation of condemnees' fishing business and which could not be practically removed from the condemned land. The district court held that the condemnees were entitled to compensation for the barges. Applying Minnesota's law of eminent domain, the court found that personal property attached to the land is considered a fixture and therefore a part of the land. The barges were found to be adapted solely for condemnees' fishing operation and not practically removable from the lake bordering the condemned realty. Because the government had condemned all the land surrounding the lake rendering the barges inaccessible, and because the peculiar nature of the barges made abandonment necessary, condemnation of the land constituted a substantial, direct, and immediate taking of the barges. (Schram-Florida)
W70-03765

FORDS AND PUBLIC BRIDGES (CLEARING OF FORDS AND BUILDING OF BRIDGES).

Tenn Code Ann secs 54-1101, 54-1103, 54-1107, 54-1109, 54-1113, 54-1125, 54-1128 (1968).

Descriptors: *Tennessee, *Bridges, *Bridge construction, *Local governments, Rivers, Streams, Swamps, Cost allocation, Roads, Timber, Legislation, Legal aspects, Construction costs.
Identifiers: *County courts, *Fords.

County courts may clear out fords of rivers where public roads cross. Magistrates of each district shall report to the county court which fords they think should be cleared. Methods of clearing fords are described. Two counties divided by a river may agree to jointly construct and pay for a bridge over such river. County courts have the power to construct bridges over streams or rivers running through the counties, provided such bridges shall be located near a public highway. County courts may construct free bridges within the corporate limits of county seats. Joint county and city bridges are authorized. (Duss-Florida)
W70-03773

ESTABLISHMENT OF FREE FERRIES.

Tenn Code Ann secs 54-1201 thru 54-1203, 54-1206 (1968).

Descriptors: *Tennessee, *Streams, *Public benefits, *Condemnation, Navigable rivers, Boats, Rivers, Navigable waters, Banks, Roads, Regulation, Joint costs, Financing, Legislation, Cost allocation, Non-navigable waters, Operation and maintenance, Road construction, Legal aspects.
Identifiers: *Ferries, Landings.

All counties may, through the county court, establish, equip, and operate free public ferries over any streams running through or bounding such counties. Counties have the power to condemn land for approaches to the ferries and for landings at the river banks. Such condemnation shall conform to the condemnation procedures for county roads. Two or more counties may cooperate in establishing ferries across navigable or unnavigable streams bordering such counties and share the costs of the construction among themselves. County courts have the power to appropriate money for the establishment of ferries and ferry roads on any navigable stream and for the construction of necessary roads across river bottom lands and up and down river banks to such ferries. (Duss-Florida)
W70-03774

HIGHWAYS, BRIDGES AND FERRIES (PRIVATE AND LOCAL IMPROVEMENTS).

Tenn Code Ann secs 54-1701 thru 54-1732 (1968).

Descriptors: *Tennessee, *Bridges, *Boats, *Bridge construction, Legal aspects, Civil engineering, Mill dams, Legislation, Engineering structures, Riparian rights, Streams, Navigable waters, Construction, Maintenance, Banks, Bank erosion, Riparian land, Bank stabilization, Sedimentation, Sediment control.
Identifiers: *Ferry, Ferry boats, Obstruction to navigation.

The county court authorizes private and local improvements on toll bridges, causeways across bottoms, fish traps, milldams, and ferries. A bridge, milldam, fish trap or other improvement obstructing a navigable stream is prohibited. A petitioner in order to construct a toll bridge, milldam, or other obstruction across any river or watercourse must own or have consent of the owner of land on both sides of the watercourse. Provisions cover proposed improvements on and construction of toll bridges across a stream dividing counties. The county court authorizes the erection of ferries. Where banks are owned by different persons, each owner may keep a ferry and must repair both banks. Banks or approaches to public ferries on all streams must be graded and macadamized as prescribed. After any high water the owner or keeper of a ferry must wash or shovel sediment back with the fall of the stream. Ferryboat construction is regulated. Every person licensed to keep a ferry or toll bridge must be bonded. (Powell-Florida)
W70-03775

FISH AND GAME.

Tenn Code Ann secs 51-201 thru 51-235 (1966), as amended, (Supp 1969), secs 51-236, 51-237 (Supp 1969).

Descriptors: *Tennessee, *Fishing, *Permits, *Fish conservation, Fish management, Legislation, Legal aspects, Regulation, Fishing gear, Baits, Sport fishing, Commercial fishing, Recreation, Water utilization, Fish, Brook trout, Brown trout, Rainbow trout, Administrative agencies, Minnows, Fish stocking, Ponds, Lakes, Reservoirs, Fisheries, Fish hatcheries.

Taking fish without a license is illegal. Children under sixteen and military personnel on furlough are not required to purchase a sport fishing license. License exemptions are extended to persons fishing in their resident county and to owners and tenants of farm lands and their dependent children. Certain persons are entitled to a free sport fishing license. A commercial fisherman is any person who takes or who aids and assists another in taking fish or other aquatic life from Tennessee waters for pay or the purpose of sale, barter, or exchange. Wholesale fish dealers are defined and regulated. Minnow bait dealers are regulated. Persons operating a commercial or private lake, pond, or reservoir must be licensed. Fish stocking is a Tennessee state prerogative. Persons taking or attempting to take brook, rainbow, or brown trout must have a trout license in addition to the fishing license. A catch-out pond is an artificially impounded body of water in which artificially propagated fish or rough fish are held available for anglers and purchasers. Fish farming is the rearing of artificially propagated, non-bait fish for the purpose of sale. (Powell-Florida)
W70-03776

HUNTING AND FISHING REGULATIONS.
Tenn Code Ann secs 51-401 thru 51-442 (1966), as amended, (Supp 1969).

Descriptors: *Tennessee, *Fishing, *Fish conservation, *Regulation, Legal aspects, Legislation, Administrative agencies, Suckers, Fish management, Bait fishing, Commercial fishing, Sport fishing, Baits, Fish, Fishing gear, Recreation, Sport fish, Fish stocking, Freshwater fish, Lakes, Streams, Nets, Minnows, Aquatic animals, Electrofishing.
Identifiers: *Game fish, *Grabbling.

Fishing is lawful in any lake or stream when the supply of fish adequately allows their taking without danger of extinction or depletion. The state Game and Fish Commission sets the creel, size, and

bag limits, and manner and means of taking fish during the open season. Open season on private lakes is set by the operator. Game fish are defined by species and common names. The sale and taking for sale of game fish is regulated. Fishing in Reelfoot Lake is regulated. Shooting into Tennessee waters for the purpose of taking fish is illegal. Seines are forbidden except in private waters, in waters which are replenished by annual or periodic overflows from listed waters or other waters designated by the Commission. Grabbling, the taking of fish by hand, is prohibited. The use of nets, seines, snag lines, drag lines, grab hooks, baskets, or any other form of fishing is regulated in designated areas. The taking, transporting, and sale of minnows for bait is controlled. The taking of fish, mussels, and other aquatic animal life other than game fish is required. The use of dynamite, electricity, explosives, chemicals, lime or poison in taking fish is prohibited. There is a restricted season on all species of sucker and red horse fish. (Powell-Florida)
W70-03777

FISH AND GAME (ENFORCEMENT OF GAME AND FISH LAWS).

Tenn Code Ann secs 51-701 thru 51-717 (1966).

Descriptors: *Tennessee, *Regulation, *Legal aspects, *Wildlife conservation, Legislation, State governments, Administrative agencies, Administration, Trapping, Hunting, Fishing, Judicial decisions, Wildlife, Frogs, Game birds, Habitat improvement, Wildlife management, Permits, Equipment.
Identifiers: Penalties (Criminal), Confiscation.

The Fish and Game Law provides administrative, procedural and judicial guidelines for the enforcement of its mandates. The law is enforced by the officers of the Game and Fish Commission. Penalties for violations are prescribed. Violators will be prosecuted before a justice of the peace and if found guilty will have a right of appeal to the circuit court of the county. A mistake of fact by the violator shall be no defense. Game taken illegally and illegal equipment shall be impounded and upon conviction declared contraband. Contraband shall be sold at public sale, the proceeds of which shall go to the Fish and Game Fund. All property used in violation of sections 51-425 to 51-427 of this act is declared contraband, and is subject to seizure and public sale. Claimants to such property must adhere to procedural guidelines herein requiring a hearing, posting of bond and, upon adverse ruling by the Commission Director, a review by the circuit court. Remedies provided herein are exclusionary to all others. A monthly report of all fines and forfeitures must be filed by the circuit court. The grand juries of each county shall have inquisitional powers into offenses alleged under this act. (Barnett-Florida)
W70-03778

LIABILITY OF LANDOWNER TO PERSONS USING LAND.

Tenn Code Ann secs 51-801 thru 51-805 (1966).

Descriptors: *Tennessee, *Recreation, *Land use, *Land tenure, Legislation, State governments, Regulation, Boating, Camping, Swimming, Water sports, Access routes, Hunting, Reasonable use, Camp sites, Permits, Real property, Channels, Legal aspects, Relative rights, Remedies, Damages.

A landowner is defined as the legal title holder, lessee, or occupant of any land or premises. 'Land' or 'premises' includes all real property, waters, private ways, and any timber or structures located thereon. The landowner has no duty of care to keep his land safe for entry or use by others for hunting, fishing, camping and like activities, nor is he required to give warning of hazardous conditions existing on such land. In granting permission to use his land, a landowner extends no assurances that the land is safe or that he will assume responsibility for any injury incurred. A person given permission to use the land does not acquire the status of invitee by virtue of such permission. Willful or malicious failure by the landowner to guard or warn against a dangerous condition will render him liable for injury notwithstanding this section. The landowner may be liable for damages if the injury is incurred by one who pays consideration for permission to engage in hunting, fishing, or sightseeing, or if one granted permission to use the land by the landowner causes injury to a third party on such land. (Barnett-Florida)
W70-03779

WISCONSIN FLOOD CONTROL.
For primary bibliographic entry see Field 04A.
W70-03802

OCEAN MINERALS AND THE LAW,
Hollis M. Dole.
Nat Res Lawyer, Vol 2, No 4, p 352-359, Nov 1969. 8 p.

Descriptors: *Mining, *Oceans, *Exploitation, *Placer mining, Legal aspects, Federal jurisdiction, Exploration, Oceanography, Geology, Marine geology, Continental shelf, Oil, Natural resources, Oil fields, Oil industry, State jurisdiction, State governments, Water resources development, Beds, Leases, Mineral industry.

Improved technology and depletion of mineral resources located on land have refocused attention on the seas as sources of minerals. Ocean minerals include materials dissolved or suspended in water, materials in rocks beneath the ocean, and metallic mineral deposits concentrated by oceanographic processes. The latter raise the greatest legal problems concerning operation of extraction facilities and leasing of mineral rights. The development of near-shore placers, which are accumulations of heavy minerals caused by water movements, will lead to development of offshore mineral resources. Laws must be enacted to allow near-shore placer mining or no further technological development will be possible. Most states have ignored the problem, relying on existing onshore mining legislation. This legislation is now inadequate because it applies to outdated methods of ocean floor mining. The Coastal States conference on a Multiple Use Approach to Offshore Mining Law discussed relevant legislation, but its findings are not yet published. Under the Outer Continental Shelf Lands Act the federal government is authorized to lease mineral rights in the ocean bottom. This authority should be exercised in a manner designed to encourage development of placer mining. (Dye-Florida)
W70-03822

WASTEWATER RATES AND SERVICE CHARGES IN GREAT BRITAIN,
West Hertfordshire Main Drainage Authority, Rickmansworth (England).
Richard Wood.
Journal Water Pollution Control Federation, Vol 41, No 12, p 1987-2001, Dec 1969. 14 p, 3 fig, 4 tab, 14 ref.

Descriptors: *Waste treatment, *Assessments, *Rates, *Pricing, *Taxes, Sewers, Cities, Costs, Prices, Economics, Water rates, Value, Industrial wastes, Water management (Applied).
Identifiers: *Great Britain, Service charges, Sewer charges, London.

Local government services in Great Britain are financed by levying rates on property owners. Local communities bear the full costs of wastewater treatment. Assessments of the rateable value of each property are based on the theoretical rent of the property. Wastewater treatment plants are themselves rateable, but sewers and pumping stations are not. Industrial waste charges are related to the costs of treating domestic wastewaters and are derived from formulae set up on a volume/strength/solids basis. These formulae vary with attempts to assess the 'treatability' of an industrial waste. (Knapp-USGS)
W70-03875

GRAYSON V COMM'RS OF BOSSIER LEVEE DISTRICT (COMPENSATION FOR LANDOWNERS FOR LEVEE DISTRICT DAMAGES).

229 So 2d 139-147 (2d Cir La 1969).

Descriptors: *Louisiana, *Judicial decisions, *Eminent domain, *Compensation, Levees, Drainage, Drainage districts, Riparian land, Flood protection, Channels, Channel improvement, Legislation, Navigable rivers, Severance, Flood control, Real property, Legal aspects, Condemnation, Damages, Bank stability, Dredging, Administrative agencies, Swamps, Bayous.
Identifiers: *Levee districts.

Plaintiff landowners brought an action against the Levee Board for damages resulting from the enlargement of a drainage channel. After receiving a judgment for one-half of the value of their land occupied by the Levee District, the plaintiffs appealed, complaining of an inadequate award of damages. The main issue on appeal was the nature of the plaintiffs' land. The defendants claimed that it was riparian. According to a constitutional provision compensation should be limited to the assessed value of the land. The court held that for the land to be riparian, it must have fronted on a navigable river when the land was first separated from the sovereign. Finding that the land in question was not riparian when separated from the public domain, the court held that the constitutional limitation was not applicable. The fact that the plaintiffs also owned another tract which was riparian was held to be immaterial. In addition to damages to the land, the court held that the plaintiffs were entitled to recover for the destruction of pecan trees on their land as well as for their expenses for spreading the spoil dirt that was piled on their land by the Levee District. (Schram-Florida)
W70-03903

LEGAL ACTIONS RELATING TO WATERCRAFT.

Ohio Rev Code Ann secs 4585.01 thru 4585.15 (Page 1965).

Descriptors: *Ohio, *Boats, *Damages, Legislation, Regulation, Contracts, Transportation, Bodies of water, Docks, Admiralty, Navigation, Construction, Legal aspects, Navigable waters, Remedies.
Identifiers: Penalties (Criminal).

Watercraft operating within the state are liable for injuries caused to persons or property by the watercraft, or by the captain or his agents. Such liability constitutes a lien on the watercraft. Liability may also attach for debts contracted for construction or maintenance of the craft. Claimants in any action for debt may proceed against the owner of the watercraft, the master who contracted the debt, or against the watercraft itself. It is unlawful to injure or destroy a watercraft of another. Criminal penalties for violations of the statute are provided. (Casey-Florida)
W70-03915

NAVIGATION (ERECTION OF AIDS TO NAVIGATION).

Ohio Rev Code Ann secs 4581.01 thru 4581.12 (Page 1965).

Descriptors: *Ohio, *Buoys, *Navigation, *Ohio River, Legislation, Legal aspects, Navigable waters, Transportation, Rivers, Lakes, Canals, Harbors, Ships, Boats, Recreation, Beaches, Swimming, Docks, Regulation, Permits, Coasts.
Identifiers: *Navigational aids, *Licenses.

Anyone interested in the navigation of a navigable water may erect and maintain on such waters buoys, lamps, or lanterns to facilitate navigation or to protect bathing areas. Watercraft are prohibited from entering these marked areas except in an emergency. Wharf boat owners on the Ohio River must remain open at all hours to accomodate travelers and handle freight. Licenses are required for those peddling stock in watercraft or intending to reside on a watercraft. (Casey-Florida)
W70-03916

WATER ADMINISTRATION - A SUGGESTED INSTITUTIONAL MODEL,
Clayton K. Yeutter.
University of Nebraska, Dept Agricultural Economics Rep No 46, p 1-30, Dec 1968. 30 p, 54 ref.

Descriptors: *Planning, *Water resources development, *Administration, *Water allocation (Policy), Future planning, Creativity, Governments, Administrative agencies, Marketing, Multiple-purpose projects, Research and development, Water districts, Hydrologic aspects, Model studies, Theoretical analysis, Water rights, Local governments, Water distribution (Policy), Competing uses.

If water law is to be effective, it must be preventive and not just curative. The author acknowledges the need for general guidelines for preventive water law and provides an institutional model designed to furnish these guidelines. At the top of the model is a Water Resources Board which would develop a comprehensive plan for the state, make broad policy decisions, deal with state-wide water law problems, and coordinate local activities. Local organizations, such as streamflow, groundwater, and reservoir districts would try to make water rights as measurable and transferable as possible. This model is designed to be an economically middle of the road program combining both free market allocation and agency water allocation. This means that as far as possible the free market would determine water allocation in proportion to the demanding interests. However, those interests not capable of expressing their demands in the market place would be protected by the agencies. The goal is to protect all interests through private and public regulation and to maintain a program sufficiently flexible to meet changing interests and demands. (See also W70-04011 and W70-04012). (Darragh-Florida)
W70-04010

WATER ADMINISTRATION - A SUGGESTED INSTITUTIONAL MODEL,
Clayton K. Yeutter.
University of Nebraska, Dep Agricultural Economics Rep No 46, p 2-6, Dec 1968. 5 p.

Descriptors: *Planning, *Water resources development, *Administration, *Water allocation (Policy), Future planning, Creativity, Governments, Administrative agencies, Marketing, Multiple purpose projects, Research and development, Water districts, Hydrologic aspects, Model studies, Theoretical analysis, Water rights, Local governments, Water distribution (Policy), Competing uses.

The institutional model presented here exemplifies a 'middle of the road' political-economic-administrative philosophy. It is designed to provide a system by which the concepts of market allocation and agency allocation for water use and planning can be combined so as to work effectively together. The intent of such a model is to demonstrate that the two concepts are not necessarily mutually exclusive. Here the market place will be allowed to control the allocation and use of the water supply, but there will be an agency framework available to resolve problems that the market place is not adequately equiped to handle. This model returns many of the transfer decisions to the users to be resolved by them in an atmosphere that will show which uses are most economically feasible. The trends of water planning toward more agency control have often resulted in non-economical distribution which should be avoided if possible. (See W70-04010). (Darragh-Florida)
W70-04011

WATER ADMINISTRATION - A SUGGESTED INSTITUTIONAL MODEL,
Clayton K. Yeutter.
University of Nebraska, Dept Agricultural Economics Rep No 46, p 7-17, Dec 1968. 11 p.

Descriptors: *Planning, *Water resources development, *Administration, *Water allocation (Policy), Streamflow, Ground water, Reservoirs, Future planning, Creativity, Governments, Administrative agencies, Marketing, Multiple purpose projects, Research and development, Water districts, Hydrologic aspects, Model studies, Theoretical analysis, Water rights, Local governments, Water distribution (Policy), Competing uses.

The institutional model presented is pyramidal in disign. At the peak is the Water Resources Board which is designed to promulgate and implement statewide water policy and planning. This function may necessitate sub-agencies under the Board to coordinate state and local activities, but the Board alone shall be responsible for state wide planning. At the base of the pyramid will be the local orginizations including perhaps streamflow, ground water, and reservoir districts. Local agencies can perform the task of local coordination of statewide projects. The local agency or district is also better able to communicate to the local residents the need for such planning and cooperation. (See W70-04010). (Darragh-Florida)
W70-04012

FLORIDA'S LAKES (PROBLEMS IN A WATER PARADISE),
F. Maloney, and S. Plager.
U Fla L Rev, Vol 13, No 1, p 1-82, Spring 1960, 82 p, 381 ref, append.

Descriptors: *Florida, *Lakes, *Water law, *Legal aspects, Boundaries (Property), Public rights, Riparian rights, Fishing, Swimming, Relative rights, Navigable waters, Non-navigable waters, Boating, Access routes, Recreation, Consumptive use, Non-consumptive use, Meanders, Hunting, Piers, Landfills, Ownership of beds, Legislation, Judicial decisions, State governments.
Identifiers: Rights of commercial users.

This is the third in a series of articles on Florida water law discussing: (1) navigability and public rights; (2) rights attributable to navigable lakes; and (3) rights attributable to non-navigable lakes. Headings one and two contain subdivisions. Subdivisions under the first heading deal with: (1) early common law developments; (2) American definitions of navigability; (3) the relationship between meandering and navigability; (4) Florida's trust doctrine; (5) possible statutory extension of navigability; (6) additional possibilities for the recognition of public rights; (7) possible use of Spanish civil law to bolster public rights; and (8) access to non-navigable lakes by invitation of riparians. Subdivisions under heading two deal with: (1) rights of riparian owners; (2) rights of the public; and (3) rights of commercial users. As they relate to the subdivisions under heading two, the following are also discussed: (1) non-consumptive uses; (2) consumptive uses; (3) access and navigation; (4) fishing, swimming and hunting; (5) wharf and fill; (6) view; (7) lake levels; (8) passage along the shore; and (9) boating. An appendix sets forth the location, by county, township, and range, of Florida's meandered lakes. (See W70-04014 thru W70-04019). (Marsee-Florida)
W70-04013

FLORIDA'S LAKES (NAVIGABILITY AND PUBLIC RIGHTS),
F. Maloney, and S. Plager.
U Fla L Rev, Vol 13, No 1, p 1-4, Spring 1960, 4 p, 16 ref, append.

Descriptors: *Florida, *Lakes, *Watercourses (Legal), *Public rights, Navigable waters, Ponds, Non-navigable waters, Legal aspects, State governments, Ownership of beds, Water law, Bodies of water, Standing waters, Surface waters, Bogs, Swamps, Lake beds, Navigation, Civil law, Federal government, Lakes.
Identifiers: English common law.

Lawyers and hydrologists tend to distinguish a natural lake or pond from a natural watercourse on the basis that water in a watercourse has a continuous motion, whereas in a lake or pond the water is substantially at rest. Although roughly accurate, this is an oversimplification. More accurately, a lake is essentially a close or self-contained system whereas watercourses are open systems serving as conveyors of surplus water from land to sea. The difference between a lake and pond is one of size. This article will attempt to trace the extent to which the law of lakes and ponds has turned on these differences. Florida's approach to navigability and public rights has been influenced both by common law developments and the Spanish civil law background of the state. Both will be examined. English common law granted or denied private and public rights in natural bodies of water on the basis of whether the water was navigable or non-navigable. The question of navigability was one of law, and although American courts adopted the concept of navigability, they have redefined the criteria. Different jurisdictions have developed varying definitions of navigability. (See W70-04013). (Marsee-Florida)
W70-04014

FLORIDA'S LAKES (TESTS OF NAVIGABILITY),
F. Maloney, and S. Plager.
U Fla L Rev, Vol 13, No 1, p 4-15, Spring 1960. 11 p, 54 ref, append.

Descriptors: *Florida, *Lakes, *Public rights, *Navigable waters, Non-navigable waters, Legal aspects, Judicial decisions, State governments, Federal government, Lake beds, Navigation, Public lands, Ownership of beds, Water law, Bodies of water, Legislation, Surface waters, Recreation demand, Recreation.
Identifiers: Trust doctrine.

The federal test of navigability uses the criterion of the commerical utility of the body of water in question; it is a test of navigability in fact and allows inclusion of artifically improved waterways. Florida differs by requiring waters to be navigable in their natural state but has to date applied a commercially oriented criterion similar to the federal one. Florida courts have not yet expressly decided whether navigability embraces navigation for purely recreational purposes. Immediately following the acquisition of Florida by the United States, federally employed surveyors meandered those lakes they judged navigable. However, due to the difficulty of meandering swampy shorelines, relatively few lakes were ultimately meandered. The fact that a lake was meandered is accepted by Florida courts as evidence of navigability and therefore of public ownership, but the failure to meander a lake has been held to not conclusively evidence that it is not navigable. Navigability in fact is again the test; therefore, non-meandered lakes may be available for public use. Florida has adopted the trust doctrine and takes the position that the state holds title to lands under navigable waters in trust for the people. (See W70-04013). (Marsee-Florida)
W70-04015

FLORIDA'S LAKES (RIGHTS IN LAKES),
F. Maloney, and S. Plager.
U Fla L Rev, Vol 13, No 1, p 15-22, Spring 1960. 7 p, 30 ref, append.

Descriptors: *Florida, *Lakes, *Public rights, *Recreation demand, Navigable waters, Non-navigable waters, Legal aspects, Civil law, Judicial decisions, Legislation, State governments, Riparian land, Riparian rights, Riparian waters, Lake beds, Recreation, Navigation, Public lands, Ownership of beds, Water law, Bodies of water, Surface waters.

In addition to the possibility of a judicial broadening of the definition of navigability, Florida might also bolster public rights of recreation by: (1) statutorily extending the concept of navigability; (2) creating special development and water conservation districts; (3) establishing a dedication of an easement for public use in non-meandered lakes; (4) granting special tax treatment to riparians who permit the public to gain access to water over their lands; and (5) utilizing Spanish civil law. Spanish civil law, unlike common law, saw nothing inconsistent in the sovereign's conveying the bottoms of certain lakes to private individuals while at the same time preserving the right of the public to traverse the water. Because of the civil law background of Florida, the Florida courts might be willing to recognize these Spanish doctrines as aids in sustaining the recognition of public rights in public waters. (See W70-04013). (Marsee-Florida)
W70-04016

FLORIDA'S LAKES (RIGHTS ATTRIBUTABLE TO NAVIGABLE LAKES),
F. Maloney, and S. Plager.
U Fla L Rev, Vol 13, No 1, p 22-55, Spring 1960. 34 p, 165 ref, append.

Descriptors: *Florida, *Riparian rights, *Consumptive use, *Non-consumptive use, Riparian water, Public rights, Judicial decisions, Water rights, Navigation, Recreation, Withdrawal, Access routes, Fishing, Swimming, Hunting, Landfill, Water levels, Piers, Domestic water, Industrial water, Agriculture, Municipal water, Water supply, Lakes, High water mark.
Identifiers: View.

In Florida, as in most Eastern jurisdictions, riparian rights are property. To be entitled to such rights, an owner must prove his ownership of the land to the high water mark. One question is the location of that mark. Riparian rights in a navigable lake can be considered under two headings: consumptive uses and non-consumptive uses. Non-consumptive used include access and navigation, fishing, swimming, hunting, wharf and fill, view, and lake level control. These rights are discussed in light of Florida case and statutory law. Due to the abundance of easily tapped grownd water sources, Florida's lakes and streams have not been looked upon as a source of water supply by major consumptive users; both agricultural and industrial. Florida's water law with respect to consumptive uses has generally developed within the riparian system. Early cases put primary emphasis upon riparian rights of use for domestic purposes. Reasonableness of the use was not a consideration. Today, the state of Florida law with respect to withdrawal for consumptive uses is clear. Florida cases are here examined and a municipality's right, as a riparian owner, to withdraw water to supply its inhabitants is discussed. (See W70-04013). (Marsee-Florida)
W70-04017

FLORIDA'S LAKES (RIGHTS OF THE PUBLIC),
F. Maloney, and S. Plager.
U Fla L Rev, Vol 13, No 1, p 55-63, Spring 1960. 9 p, 47 ref, append.

Descriptors: *Florida, *Public rights, *Non-consumptive use, *Navigable waters, Lakes, Riparian rights, Judicial decisions, Eminent domain, Legislation, Navigation, Recreation, Fishing, Hunting, Boating, Access routes, Parks, Shores, Regulation, Recreation demand, Lake beds, Relative rights, Swimming, Legal aspects, State governments, High water mark.
Identifiers: View.

The establishment of navigability is presently the foundation of public rights in Florida's lakes; however, the nature and extent of such rights have received very little judicial or legislative consideration. The mere fact that a lake is navigable does not guarantee public access to it. Courts generally agree that members of the public have no right to cross private property to reach navigable waters. The use of legislation or eminent domain may possibly be a means of establishing such public access. As to rights of passage and recreation along the shore of a navigable lake, since Florida holds that the riparian owner owns only to the high water mark, it may be that the public will have a right to the land between the high and low water marks. Once on a navigable lake in Florida, a member of the public has a right to use it for boating, swimming, fishing, and hunting, all subject to regulation. The right of the public to scenic enjoyment of navigable waters has not been discussed by Florida courts. Even if recognized, however, the right will have to be weighed against other public interests. (See W70-04013). (Marsee-Florida)
W70-04018

FLORIDA'S LAKES (RIGHTS OF COMMERCIAL USERS),
F. Maloney, and S. Plager.
U Fla L Rev, Vol 13, No 1, p 53-73, Spring 1960. 11 p, 62 ref, append.

Descriptors: *Florida, *Consumptive use, *Non-consumptive use, *Non-navigable waters, Commercial fishing, Boating, Hunting, Public rights, Relative rights, Judicial decisions, Legislation, Legal aspects, State governments, Lakes, Land tenure, riparian rights, recreation demand, Regulation, Leases, Lake beds, Access routes, Trees, Crustaceans, Ownership of beds.
Identifiers: Minerals, Sponges.

Non-consumptive commercial uses of Florida's navigable lakes fall into two categories: commercial navigation, and commercial fishing and hunting. Subject to regulation of unreasonable uses, a riparian owner may for commercial purposes make access to navigable lakes available to the public, and members of the public may engage in commercial fishing. Consumptive commercial uses of navigable lakes include: consumptive use of the water; and uses that are consumptive of mineral deposits underlying the lake or of substances on the bed, such as sponges, crustaceans, or cypress trees. As relates to consumptive use of things on or under lake beds, Florida has legislatively authorized the sale of minerals and timber under navigable waters, as well as the sale or leasing of the right to drill for petroleum and gas. A determination that a lake is non-navigable generally excludes the public from the use of the lake. Such lake may be owned by one or more individuals who may control it as any other piece of realty. The relative rights of such multiple owners of the lake are discussed as well as the state's right to regulate such lake. (See W70-04013). (Marsee-Florida)
W70-04019

WATER SUPPLY DISTRICTS.

Mo Ann Stat secs 247.010 thru 247.220 (1959), as amended, (Supp 1970).

Descriptors: *Missouri, *Water districts, *Water supply, *Water management (Applied), Legal aspects, Legislation, Water works, Water resources development, Water allocation (Policy), Water distribution (Applied), Sanitary engineering, Public utilities, Water rates, Condemnation, Water utilization, Eminent domain, Administrative agencies, Administration, Conduits, Environmental sanitation, Civil engineering, Construction, Maintenance.

Public water supply districts, as Missouri political corporations, promote public health and sanitation and provide conveniences in the use of water, namely ample quantity and pure and wholesome quality. Procedures for the formation of a public water supply district are enumerated. Each district is authorized to purchase or otherwise acquire water for the necessities of the district; to build, acquire by purchase or otherwise enlarge, improve, extend and maintain a system of waterworks; and to acquire private property by condemnation. The water supply district sells and distributes water to the inhabitants of the district and to consumers outside the district and fixes rates for the sale of water. A board of directors manages the business and affairs of the district. The organization and operation of the board is regulated. Methods of financing district projects are enumerated. The district has the right to lay its mains in public highways, roads, streets, and alleys in the district. The procedure for condemnation of property is designated. The district which is dependent upon purchases of water to supply its needs may sell and convey part or all of its water mains, plant, real estate, or equipment to any water corporation. The procedure for dissolution of a public water supply district is enumerated. (Powell-Florida)
W70-04022

SEWER DISTRICTS (CONSTRUCTION OF SEWERS IN UNINCORPORATED JURISDICTIONS).
Mo Ann Stat secs 249.430 thru 249.667 (1959), as amended, (Supp 1970).

Descriptors: *Missouri, *Public utility districts, *Sewage districts, *Sewers, Legal aspects, Legislation, Construction, Maintenance, Local governments, Engineering structures, Sewage disposal, Administrative agencies, Condemnation, Eminent domain, Right-of-way, Assessments, Project planning, Jurisdiction, Construction costs, Cost allocation, Operation and maintenance, Financing, Cost-benefit theory.

A majority of the landowners residing in an unincorporated area may petition the county court to establish a sewer district and provide for construction of sewers therein. The county court may designate the county highway engineer to serve as sewer engineer. The sewer engineer is responsible for advising the county court in matters relating to the establishment and maintenance of a sewer district. Sewers may be constructed to serve more than one sewer district when the county court deems this necessary. The court may condemn land or other property to secure rights-of-way for sewer construction, or for construction of other improvements. Provisions are set forth for the apportionment of costs among landowners within the district. Upon the recommendation of the sewer engineer, the county court may levy special assessments for the operation, maintenance, and repair of sewers within the district. Procedures for dissolutionment of a district are provided. (Powell-Florida)
W70-04023

CLASS TWO COUNTIES - SEWER DISTRICTS.
Mo Ann Stat secs 249.760 thru 249.810 (1959).

Descriptors: *Missouri, *Sewage districts, *Sewage treatment, *Sewage disposal, Legislation, Legal aspects, Land tenure, Boundaries (Property), Contracts, Regulation, Ditches, Utilities, Jurisdiction, Construction, Condemnation, Rates, Maintenance, Financing, Outlets, Repairing, Taxes, Estimated costs, Local governments, Pollution abatement.
Identifiers: *Sewer districts, Bonds.

Any contiguous area lying within a second class county may be incorporated as a sewer district upon the filing of a petition with the circuit court by a majority of the property owners in such area. The petition will give the reasons a sewage treatment facility and sewer system are needed. The incorporation process is outlined. Sewer districts shall have the power to: (1) elect a board of supervisors to manage district affairs; (2) contract and acquire property; (3) lay sewer lines in public roadways; (4) furnish sewage disposal outlets and construct, acquire, improve, operate, maintain and administer disposal systems, sewage treatment plants,

mains, laterals, drains and other appurtenances incidental thereto; (5) authorize the use of their facilities by other governmental subdivisions so far as the facilities' capacities are sufficient beyond the needs of the district; and (6) be parties to joint cooperative projects. The board of supervisors will establish rates for the use of the sewer districts' facilities. District administration and dissolution are provided for. The methods of financing through taxation and bond issuance are outlined. (Keith-Florida)
W70-04024

FISH AND GAME (THE WILDLIFE AND FORESTRY LAW).

Mo Ann Stat secs 252.010 thru 252.230 (1959).

Descriptors: *Missouri, *Fish management, *Fish conservation, *Water pollution effects, Legislation, Legal aspects, Wildlife, Fish, Aquatic life, Regulation, Administrative agencies, Permits, Wildlife management, Wildlife conservation, Rivers, Streams, Dams, Nets, Weirs, Fish barriers, Fish ladders, Fish passages, Pollutants, Explosives, Water pollution, Fishkill, Fish hatcheries, Supervisory control (Power).
Identifiers: *Penalties (Criminal).

Wildlife includes all wild birds, mammals, fish and aquatic life. No wildlife will be taken except in the manner, to the extent and at the times permitted by the Conservation Commission. Commission agents may search creels, containers, gamebags, autos and boats which the agents have reason to believe contain unlawfully transported or possessed wildlife. Persons owning or operating dams will erect and maintain a fishway or other device which will enable fish to have free passage through such dams. If such devices are impractical, the Commission may require the establishment of hatcheries to stock the waters above and below the dams. It is unlawful for any person to place any seine, screen, net, weir, fish dam, or other obstruction across any watercourse to obstruct the free passage of fish. It is unlawful for any person to cause any deleterious substance or explosive to be placed into any waters in quantities sufficient to injure or kill fish. Criminal penalties are provided for violation of any of the provisions of this chapter. (Keith-Florida)
W70-04026

LEASES OF FEDERAL RESERVOIR LANDS FOR RESORT PURPOSES.

Mo Ann Stat secs 253.290 thru 253.320, as amended, (Supp 1970).

Descriptors: *Missouri, *Administrative agencies, *Leases, *Land development, Operation and maintenance, Federal government, Construction materials, Construction, Conservation, Architecture, Design, Land management, Land use, Legal aspects, Legislation, Reservoirs, Recreation facilities, Parks.

The Missouri Park Board may grant leases for the development of resort facilities on federal reservoir lands which have been purchased by the state. Leases may not exceed fifty years in duration. Leases are to be granted only on the basis of competitive bidding. The Board retains the right to enter leased lands at all times. The Board may control the quality of construction materials used in the facilities and may regulate the fees charged to the public for use of the facilities. Lessees must maintain and conserve the lands and keep accurate records of their operations. Lessees may execute construction mortgages, subject to the Board's approval. (Duss-Florida)
W70-04027

WATER RESOURCES BOARD.
Mo Ann Stat secs 256.180 thru 256.260 (1959), as amended, (Supp 1970).

Descriptors: *Missouri, *Administrative agencies, *Water resources, *Water resources development, Surveys, Data collection, Investigations, Grants, Bodies of water, Federal government, Regulation, Legislation, Water management, Water utilization, Real property, Legal aspects.

A Water Resources Board is hereby created. It is the duty of the Water Resources Board to develop a long-range, comprehensive, state-wide program for the conservation, development, management, and use of state water resources. The Board is to collect data and make surveys, investigations, and recommendations concerning water resources and their relation to social and economic needs. The Board will act as a clearing house for water resources data collected by other agencies. It may enter upon any lands or waters for investigative purposes. The Board may cooperate with the United States or any federal or state agency. The Board must employ an engineer experienced in water resources as its executive director. The Governor may delegate additional authority to the Board. (Duss-Florida)
W70-04028

WATER CONSERVANCY DISTRICTS.
Mo Ann Stat secs 257.320 thru 257.490 (1959).

Descriptors: *Missouri, *Water districts, *Water conservation, *Taxes, Government finance, Administrative agencies, Water management (Applied), Legal aspects, Legislation, Financing, Economics, Administration, River basins.

The types of funds which may be used by a conservancy district and the use of money acquired as aid from a public agency are described. Tangible property within the district may be taxed. General obligation bonds may be issued by the board of trustees of a river basin conservancy district. The procedures for disincorporation of a conservancy district are enumerated. (Powell-Florida)
W70-04031

BOUNDARIES BY WATERCOURSES.
Mo Ann Stat sec 46.010 (1966).

Descriptors: *Missouri, *Watercourses (Legal), *Boundaries (Property), *Channels, Legislation, Surveys, Local governments, Legal aspects, Water law, Jurisdiction.
Identifiers: Counties.

Whenever a county is bounded by a watercourse the boundary shall be construed to be the middle of the main channel of the watercourse. Range, township, and sectional lines shall be construed as conforming to the established surveys. (Schram-Florida)
W70-04039

TAXATION OF BRIDGE AND PUBLIC UTILITY COMPANIES.

Mo Ann Stat secs 153.030, 153.040 (1952).

Descriptors: *Missouri, *Taxes, *Bridges, *Public utilities, Legislation, Assessments, Tax rate, Railroads, Cities, Local governments, Electric power, Real property, Pipelines, Payment, Utilities, Navigable waters, Streams.
Identifiers: *Toll bridges.

All private bridges over streams dividing this state from other states, all toll bridges across navigable streams, and all property owned by public utility companies are subject to taxation for state, county, municipal, and other local purposes to the same extent as the property of private persons. Taxes on these properties shall be levied and collected in the same manner as provided for the taxation of railroad property. Details of the taxation procedures are provided. In cases where a part of any bridge is in this state and a part in another state, only the portion of the bridge in this state shall be subject to assessment and taxation. (Schram-Florida)
W70-04042

NATIONAL RIVERS AND HARBORS CONGRESS SUPPORTS A COMPREHENSIVE WATER RESOURCES DEVELOPMENT PROGRAM,
William J. Hull.
Congressional Record, 91st Cong, 1st Sess, Sept 22, 1969.

Descriptors: *Water resources development, *Project planning, *Federal project policy, *Legislation, Cost-benefit analysis, Economics, Water Resources Planning Act, Project purposes, Planning, Project benefits, River basin development, Navigation, Flood control, Low-flow augmentation, Dams, Water management (Applied), Reservoir operation, Water requirements, Administration, Multiple-purpose projects.
Identifiers: Water resource objectives, Project evaluation.

Senator Birch Bayh states that an imperative need exists for an accelerated program of comprehensive water resource development to meet the rising water requirements of increasing population and an expanding economy. Existing criteria for the evaluation of water resource development projects are needlessly restrictive. Most water resources projects produce benefits which are often overlooked, and most projects are multi-purpose whether so recognized or not. Congress should develop national water resource goals and objectives based on economic grounds and value judgments. It is argued that a river basin approach to water resource planning should be adopted by Congress and that existing procedures whereby improvements are authorized on a project-by-project basis should be changed. This multi-purpose basin approach should apply to the whole process by which water resources projects are initiated and developed. (Caldwell-Florida)
W70-04043

ADMINISTRATIVE ARRANGEMENTS FOR WATER RESOURCES DEVELOPMENT IN MONTANA,
Montana State Univ., Bozeman.
Richard Sheridan.
Montana University Joint Water Resources Research Center, (1969). 3 p OWRR Project B-004-MONT.

Descriptors: *Administrative agencies, *Political aspects, *Resource development.
Identifiers: *Politico-administrative, *Water and land resources, *Restructuring, *Efficient administrative arrangement.

This study deals with the nature of the politico-administrative aspects of resources development in Montana, with particular emphasis on water resources. An extensive bibliography has been prepared relating to the general source materials about Montana's water and land resources. A review was also made of the formal organization for natural resources administration in all of the fifty states. Finally, an analysis was made of the needed restructuring of the administrative agencies within Montana to provide an efficient administrative arrangement for water resources development.
W70-04044

6F. Nonstructural Alternatives

AN ACTIVITY ANALYSIS OF NON-STRUCTURAL PLAIN MANAGEMENT ALTERNATIVES: CHAPTER IV,
Wisconsin Univ., Madison. Water Resources Center.
John C. Day.
Wisconsin Water Resources Center, Madison, Final Report (Partial), p 54-111, 1969. 58 p, 20 tab, 7 ref. OWRR Project B-002-WIS.

Descriptors: *Linear programming, *Management, *Flood plains, *Floodproofing, Land development, Models, Rent, Zoning, Landfills.
Identifiers: Site elevation.

A linear programming solution to a flood plain management problem was developed. The objective was to choose the appropriate land activities for a presently vacant tract of land lying in a flood hazard location. Two basic residential models were designed allowing for two different degrees of site elevation through the use of a land fill. Along with the programming models, an extensive 'side-calculation', employing the regression estimates of rents, the expected flood losses for all residential land use-location combinations and estimated costs for elevation and floodproofing, identified the set of activities that yielded positive rent. The solution was placed at the disposal of the flood plain manager a residential development plan that served as a guide for zoning, subdivision control, and building code regulations. (See W70-04002). (Thiuri-Cornell)
W70-04003

6G. Ecologic Impact of Water Development

THE FUTURE OF THE NORTH CAROLINA COASTAL AREA.
For primary bibliographic entry see Field 05G.
W70-04032

07. RESOURCES DATA

7A. Network Design

A PROPERTY OF THE RANGE OF PARTIAL SUMS,
Geological Survey, Washington, D.C.
N. C. Matalas, and C. S. Huzzen.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 33, p 252-257, 1967. 6 p, 1 tab, 8 ref.

Descriptors: *Time series analysis, *Markov processes, *Statistical methods, Probability, Stochastic processes, Time lag, Runoff forecasting, Streamflow forecasting.

Under the assumption that time series are generated by lag-one Markov processes, an investigation was made of the degree to which serial dependence and skewness affects the ratio of the range of cumulative departures from the sample mean to the sample standard deviation. From a large number of generated sequences, the mean value of k was determined for various values of N, lag-one serial correlation, p (1), and skewness. For all values of N and p (1), skewness had no effect. Within the range of values of N and p (1) for annual sequences of river discharge, the average of values agrees with that found in observed sequences. This indicates that a lag-one Markov process may be a good approximation to the generating process of sequences of annual river discharge and that apparent long-term movements in these sequences are chance events. (Knapp-USGS)
W70-03701

DISTRIBUTION OF INTERIOR LINK LENGTHS IN NATURAL CHANNEL NETWORKS,
IBM Watson Research Center, Yorktown Heights, N.Y.
For primary bibliographic entry see Field 02E.
W70-03878

EXTENSION OF RAINFALL RECORDS BY INTERSTATION CORRELATION,
Stanford Univ., Calif. Dept. of Civil Engineering.
Molina Medardo.
Available for $2.00 per copy, from Stanford University, School of Engineering, Stanford, California 94305. Technical Report No 123, Dec 1969. 128 p, 24 fig, 16 tab.

Descriptors: *Precipitation, *Hydrologic data, *Correlation analysis, California.
Identifiers: Guatemala, Venezuela, Interstate correlation.

The feasibility of extending short precipitation records by correlation with nearby stations having longer records is explored. Analysis is made for annual, monthly, and daily data. Linear regression analysis is used with a random term to allow for departures from the mean relation. Data from California, Guatemala, Venezuela are used in the study. The study indicates that an initial period of record of about 15 years is adequate to establish the correlation required and that extension to stations up to 60 miles from the base station is possible when regional variability of rainfall is high and that even longer distances are possible where regional variability is relatively low. Technique is specifically designed to be of value in developing countries where few long-record rainfall stations exist. (Linsley-Stanford)
W70-03932

7B. Data Acquisition

GAMMA-RAY SPECTROSCOPY AS A TOOL FOR A RAPID INVESTIGATION OF DETRITIC CORES,
Centre National de la Recherche Scientifique, Gif-sur-Yvette (France). Centre des Faibles Radioactivities.
Lydie Chenouard, and Claude Lalow.
Journal of Sedimentary Petrology, Vol 39, No 4, p 1477-1483, Dec 1969. 7 p, 5 fig, 3 tab, 12 ref.

Descriptors: *Gamma rays, *Spectroscopy, *Analytical technique, *Sediments, *Detritus, Cores, Stratigraphy, Climatic zones, Potassium, Particle size, Radium radioisotopes, Sedimentation rates, Geochemistry.
Identifiers: Gamma-ray spectrometry.

The nondestructive gamma-ray spectroscopy of a sedimentary core was used to identify five great zones of variation of potassium and thorium content in Atlantic continental shelf sediments. A sedimentological and paleoclimatic study shows that those variations correspond to climatic fluctuations. It is then concluded that nondestructive gamma-ray spectroscopy may be a valuable tool for a rapid investigation of sedimentary cores. (Gabriel-USGS)
W70-03650

USER TRIALS OF A SUBMERSIBLE WATER QUALITY RECORDING METER,
Ontario Water Resources Commission, Toronto. Great Lakes Survey Program.
For primary bibliographic entry see Field 05A.
W70-03662

THE INFRA-RED DETERMINATION OF QUARTZ IN SEDIMENTS AND SEDIMENTARY ROCKS,
Liverpool Univ. (England). Dept. of Oceanography.
R. Chester, and R. N. Green.
Chemical Geology, Vol 3, No 3, p 199-212, Sept 1968. 14 p, 8 fig, 2 tab, 13 ref.

Descriptors: *Quartz, *Infrared radiation, *Analytical techniques, *Sediments, Sedimentary rocks, Spectrophotometry, Rock properties, Particle size, Sampling, Laboratory tests, Methodology.
Identifiers: *Infrared technique, *Quartz adsorption band, Potassium bromide discs.

An infrared technique is described for use in making rapid, accurate determination of quartz. Quartz is an important component of many sediments and sedimentary formations, and information on its destribution is necessary for interpretation of ecological, mineralogical and geochemical conditions of deposition. The technique described utilizes introduction of sediment samples to the spectrophotometer in a solid form as KBr discs, and is made quantitative by controlling the volume of material in each disc. Quartz content of 16 sedimentary rocks and synthetic standards were analyzed by the technique; results are in good agreement with those obtained by chemical and X-ray methods. (Lang-USGS)
W70-03678

COLOR PHOTOGRAPHS FOR WATER RESOURCES STUDIES,
Geological Survey, Washington, D.C.
William J. Schneider.
Photogrammetric Engineering, p 257-262, Mar 1968. 6 p, 8 plate.

Descriptors: *Aerial photography, *Water resources, *Surveys, *Investigations, Water temperature, Water pollution sources, Vegetation effects, Topography, Land use, Water quality, Hydrogeology.
Identifiers: Color aerial photography, Infrared.

Air-photo interpretation is very well suited to water resources studies where limited observations of hydrologic data must be extended to regional characteristics for large areas. It is also useful in monitoring the hydrologic regimen of an area to detect possible changes. Color aerial photography is generally superior to black-and-white photography for these water resources investigations. Depth penetration through water, and excellent discrimination of water indicators, such as vegetation, are its main assets. Meaningful interpretation of the photography depends on adequate ground control data. Experiences of the Water Resources Division, U.S. Geological Survey, indicate that the best interpretation is done by professional personnel--engineers, geologists, and water chemists intimately associated with a particular water resources project for which the photography has been obtained. (Knapp-USGS)
W70-03680

DESIGN OF A NEUTRON SCATTERING WATER CONTENT GAGE FOR SOILS,
Illinois Univ., Urbana.
Kenneth Preiss.
In: Isotope Techinques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 22-27, 1967. 6 p, 5 fig, 7 ref.

Descriptors: *Nuclear moisture meters, *Calibrations, *Neutron absorption, *Soil moisture meters, *Radiosotopes, Gamma rays, Radioactivity techniques, Gages, Cadmium radioisotopes, Fluctuation, Organic matter.
Identifiers: *Neutron scattering, Beryllium, Plutonium 239, Actinium 227, Americium 241.

Errors in the reading of a neutron scattering water content gage due to the chemical composition of the soil and to statistical fluctuations in the source emission rate are discussed. The effect of each cause of error may be minimized by correct design of the apparatus. The collision processes that may occur between neutrons and the atoms of a soil are described. It is shown that trace quantities of particular elements in the soil can reduce the reading, but a simple cadmium cover around the detector will eliminate their effect. Equations are given relating error in water content reading with the ordinate and slope of the calibration curve. Using these equations, it is shown that the time required to attain a given standard error in water content reading depends upon the distance between source and detector; a source to detector distance exists which gives a least time for a given error. (Carstea-USGS)
W70-03686

DEVELOPMENT OF A RADIOISOTOPE GAGE FOR MONITORING SEDIMENT CONCENTRATION IN RIVERS AND STREAMS,
Panametrics, Inc., Waltham, Mass.
Bach Sellers, Charles A. Ziegler, and John Papadopoulos.
In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 3-10, 1967. 8 p, 5 fig, 1 tab, 1 ref.

Descriptors: *Radioactivity techniques, *Sediment discharge, *Suspended load, *Monitoring, Gages, Streams, Rivers, Water control, Water conservation, X-rays, Cadmium radioisotopes, Instrumentation.
Identifiers: Sediment concentration gaging.

A radioisotope gage has been developed to satisfy the need for a self-powered, continuous monitoring system of sediment concentrations in rivers and streams. This gage uses X-rays from Cd 109. Basically the gage records the ratio of X-ray transmission through water containing suspended sediment and a reference cell containing distilled water. The instrument is capable of recording at 15 minute intervals over a period of 7 1/2 days with an accuracy better than 20% for sediment concentrations ranging from 1,000 to 50,000 ppm. The radioisotope gage has been field tested and it is being delivered to member agencies of the U.S. Inter-Agency Sedimentation Project for extended test and evaluation over a one-year period. (Carstea-USGS)
W70-03687

DOWNWARD MOVEMENT OF SOIL MOISTURE TRACED BY MEANS OF HYDROGEN ISOTOPES,
Heidelberg Univ. (West Germany). Physics Inst., C-14 Lab.
For primary bibliographic entry see Field 02G.
W70-03689

THE APPLICATION OF ISOTOPES TO SOME PROBLEMS IN ATMOSPHERIC SCIENCES,
Atomic Energy Commission, Washington, D.C. Biology and Medicine Div.
For primary bibliographic entry see Field 02B.
W70-03690

CONTRIBUTION OF ISOTOPE TECHNIQUES TO THE STUDY OF SOME HYDROLOGICAL PROBLEMS,
International Atomic Energy Agency, Vienna (Austria).
For primary bibliographic entry see Field 02A.
W70-03694

APPLICATION OF DEUTERIUM ANALYSES TO THE HYDROLOGY OF THE LAKES OF THE GRAND COULEE, WASHINGTON,
Geological Survey, Denver, Colo.; and Woods Hole Oceanographic Institution, Mass.
For primary bibliographic entry see Field 02K.
W70-03696

ULTRA-LOW VELOCITY MEASUREMENT IN A STRATIFIED RESERVOIR BY ISOTOPIC CURRENT METER,
Tennessee Valley Authority, Norris. Engineering Lab.
For primary bibliographic entry see Field 02H.
W70-03697

MINIMIZING NUCLEAR SOIL DENSITY AND MOISTURE CONTENT GAGE ERRORS,
North Carolina State Univ., Raleigh.
Robin P. Gardner.
Highw Res Rec, No 290, p 1-8, 1969. 8 p, 15 ref.

Descriptors: *Nuclear moisture meters, Neutron counters, *Errors, Variability, Soil density, Soil mechanics, Soil moisture, Gamma rays, *Soil moisture meters, Moisture content, Calibrations, Bibliographies, Measuring instruments, Mathematical analysis, Mathematical models, Moisture meters.
Identifiers: *Nuclear density meters, Neutron moderation method, Control equipment, Accuracy, Testing equipment.

Sources of error in nuclear soil density gages are identified as sensitivity to variations in sample composition, poor calibration techniques, and sensitivity to surface heterogeneities. Errors associated with nuclear moisture content gages are identified as sensitivity to soil composition, sensitivity to soil density, and poor calibration techniques. Several approaches are evaluated for minimizing these sources of error, including mathematical analyses of the nuclear gaging principles, the calibration model method, and the dual-gage principle for nuclear density gages. The primary source of error for the gamma-ray density gage was sensitivity to soil composition. Mathematical model studies of the gamma-ray density gage indicated that changes in any single gage design parameter minimized errors caused by variations in soil composition only at the expense of increasing errors caused by surface heterogeneities. Mathematical analysis of neutron soil moisture gages has had limited success. The calibration model method shows promise for minimizing sources of error for the neutron moisture gages and the dual-gage principle for the gamma-ray density gages. (USBR)
W70-03787

APPLICATION OF PORE PRESSURE MEASUREMENTS TO SHEAR STRENGTH OF COHESIVE SOILS,
Bureau of Reclamation, Denver, Colo.
H. J. Gibbs, and C. T. Coffey.
Bur Reclam Rep No Em-761, June 1969. 56 p, 38 fig, 3 tab, 10 ref, 3 append.

Descriptors: *Pore air pressures, *Negative pore pressure, *Pore water pressures, Capillarity, Effective stress, Soil compression tests, Soil tests, *Test procedures, Triaxial shear, Shear strength, *Pore pressure, Research and development, Cohesive soils, Laboratory tests, Soil strength, Soil engineering, Soil mechanics, Triaxial compression.
Identifiers: Triaxial tests, Soil suction, Undrained tests, Exposed end plate method, Unsaturated soils, Testing equipment.

An accurate method of measuring pore pressure in soils is necessary for determining stress when designing soil structures. The Bureau of Reclamation has made the following advances in measuring negative pore pressures: (1) The exposed end plate method of measuring the initial negative pore pressure of soils. Negative pore pressure can be determined on a routine laboratory testing basis without damaging the specimens for further testing. (2) Measuring capillary pressure throughout the volume change range as the undrained (sealed) specimens are compressed from initial negative pore pressure to the point where the capillary pressure becomes zero at saturation. Results of this test conducted on one of a series of specimens, together with results of the exposed end plate test on each specimen of the series are applied in the analysis of soil strength from shear test results. (3) Improved accuracy in measuring pore air pressure by separating the water film in the soil from the end plate measuring device and controlling the end plate so that water is not drawn into or from the soil. Variable soil stress conditions that would be introduced by changing soil moisture conditions are eliminated. (USBR)
W70-03788

A BATTERY POWERED PROPORTIONAL STREAM WATER SAMPLER,
Forest Service (USDA), Corvallis, Oreg. Pacific Northwest Forest and Range Experiment Station.
R. L. Fredriksen.
Water Resources Research, Vol 5, No 6, p 1410-1413, Dec 1969. 4 p, 4 fig.

Descriptors: *Sampling, *Instrumentation, *Water quality, Water analysis, Data collections, Automation, Equipment.
Identifiers: Water samplers.

A stream water sampler was designed and tested to sample water from a stream at a rate proportional to the streamflow rate. A composite of samples taken in this manner is an estimate of the mean concentration of constituents carried by the stream while the sample was collected. The instrument is suitable for estimates of transport of suspended or dissolved constituents in small streams. The sampler can be built for under $1000. (Knapp-USGS)
W70-03856

A TEN-UNIT WATER LEVEL SENSING AND RECORDING SYSTEM,
Maryland Univ., College Park.
Robert M. Ragan, and Alan B. Hais.
Water Resources Research, Vol 5, No 6, p 1414-1417, Dec 1969. 4 p, 2 fig.

Descriptors: *Water levels, *Water level fluctuations, *Sampling, Automation, Instrumentation, Equipment, Stream gages.
Identifiers: Water level recorders.

An instrument to record a number of water levels on one chart for field studies was developed around a float-pulley mechanism attached to the shaft of a potentiometer. A timing circuit allows one 6-second recording cycle each minute for each of 10 sensors. Drift due to battery drain has not been encountered, and field performance has been satisfactory at a total cost of less than $400. (Knapp-USGS)
W70-03857

APPLICATIONS OF COLOR AERIAL PHOTOGRAPHY TO WATER RESOURCES STUDIES,
Geological Survey, Washington, D.C.
William J. Schneider, and Milton C. Kolipinski.
Reprinted from Proc 1969 Seminar on Remote Sensing. Geological Survey Duplicated Report, p 257-262, 1969. 6 p, 16 ref.

Descriptors: *Aerial photography, *Water resources, *Surveys, *Investigations, Water temperature, Water pollution sources, Vegetation effects, Topography, Land use, Water quality, Hydrogeology.
Identifiers: Color aerial photography, Infrared.

Air-photo interpretation is very well suited to water resources studies where limited observations of hydrologic data must be extended to regional characteristics for large areas. It is also useful in monitoring the hydrologic regimen of an area to detect possible changes. Color aerial photography is generally superior to black-and-white photography for these water resources investigations. Depth penetration through water, and excellent discrimination of water indicators, such as vegetation, are its main assets. Meaningful interpretation of the photography depends on adequate ground control data. Experiences of the Water Resources Division, U. S. Geological Survey, indicate that the best interpretation is done by professional personnel--engineers, geologists, and water chemists intimately associated with a particular water resources project for which the photography has been obtained. (Knapp-USGS)
W70-03869

DETERMINING SPECIFIC YIELD OF THE OGALLALA AQUIFER BY THE NEUTRON METHOD,
Agricultural Research Service, Bushland, Tex. Southwestern Great Plains Research Center.
For primary bibliographic entry see Field 02F.
W70-03871

RADIOCARBON DETERMINATIONS APPLIED TO GROUNDWATER HYDROLOGY,
Geological Survey, Washington, D.C.; and Geological Survey, Denver, Colo.
For primary bibliographic entry see Field 02F.
W70-03890

DEVELOPMENT OF ISOTOPE METHODS APPLIED TO GROUNDWATER HYDROLOGY,
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotopes.
A. Nir.
In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 109-116, 1967. 8 p, 5 fig, 10 ref.

Descriptors: *Radioisotopes, *Radioactivity techniques, *Tracking techniques, Radioactive dating, Underground storage, Dispersion, Research and development, Groundwater movement, Hydrology, Hydrologic cycle, Hydrogeology.
Identifiers: Isotopes in groundwater hydrology.

A survey of development of isotope methods in hydrology reveals that the initial high hopes have been only partly fulfilled. Only a few defined areas of specific and local application have been advanced, such as determination of point velocity, aquifer storativity, hydrodynamic dispersion coefficients, and transit times through age determination. A critical evaluation of present methods of isotope data interpretation to groundwater analysis indicates that the assumptions made and the results obtained are often not compatible with the problems and approaches of the practicing hydrologists. Modifications of this approach may, however, enable comparison of isotope survey results with those obtained by other conventional methods. More basic contribution of isotope methods to hydrology seems feasible in view of this analysis and of the state of experimental techniques. It first requires, however, a more concerted effort in selected hydrological basins where diverse isotope and conventional methods could be applied and evaluated in close cooperation between hydrologists and the physical (isotope) scientists. The international hydrological decade offers a suitable opportunity for such an undertaking on a regional scale. (Carstea-USGS)
W70-03891

GROUNDWATER FLOW AND DIRECTION MEASUREMENT BY MEANS OF RADIOISOTOPES IN A SINGLE WELL,
For primary bibliographic entry see Field 02F.
W70-03892

USE OF CHEMICAL AND RADIOACTIVE TRACERS AT THE NATIONAL REACTOR TESTING STATION, IDAHO,
National Reactor Testing Station, Idaho Falls, Idaho.
For primary bibliographic entry see Field 02F.
W70-03893

LARGE-SCALE UTILIZATION OF TRITIUM IN HYDROLOGIC STUDIES,
Stockholm Univ. (Sweden). International Meteorological Inst.
For primary bibliographic entry see Field 02A.
W70-03894

RADIOCARBON AGES OF GROUNDWATER IN AN ARID ZONE UNCONFINED AQUIFER,
Instituto Venezolano de Investigaciones Cientificas, Caracas.
For primary bibliographic entry see Field 02F.
W70-03895

TECHNIQUES OF GROUNDWATER TRACING USING RADIONUCLIDES,
Atomic Energy of Canada Ltd., Chalk River (Ontario).
For primary bibliographic entry see Field 02F.
W70-03896

FRACTIONATION OF TRITIUM AND DEUTERIUM IN SOIL WATER,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02G.
W70-03897

ENVIRONMENTAL TRITIUM STUDIES AT THE NATIONAL REACTOR TESTING STATION,
Atomic Energy Commission, Idaho Falls, Idaho.
For primary bibliographic entry see Field 05B.
W70-03898

THE USE OF A TRACER TEST TO VERIFY AN ESTIMATE OF THE GROUNDWATER VELOCITY IN FRACTURED CRYSTALLINE ROCK AT THE SAVANNAH RIVER PLANT NEAR AIKEN, SOUTH CAROLINA,
Geological Survey, Aiken, S.C.
For primary bibliographic entry see Field 02F.
W70-03899

WATER TRACING IN THE HYDROLOGIC CYCLE,
International Atomic Energy Agency, Vienna (Austria).
For primary bibliographic entry see Field 02A.
W70-03900

THE USE OF REMOTE SENSING IN WATER RESOURCE MANAGEMENT,
Stanford Research Inst., Menlo Park, Calif.
Robin I. Welch.
Proceedings of the Eutrophication-Biostimulation Assessment Workshop, June 19-21, 1969, California Univ, Berkeley, Sanitary Engineering Research Lab and National Eutrophication Research Program, Corvallis, Ore, Pac Northwest Water Lab, p 227-242. 8 fig, 3 tab, 3 ref.

Descriptors: *Remote sensing, *Water resources, *Water management (Applied), Synoptic analysis, Analytical techniques, Marine plants, Planning, Water pollution, Aquatic environments, Aerial photography, Light quality, Dye releases, Oysters, Fluorometry, California, Silting.
Identifiers: Data acquisition, Marine resources, Freshwater resources, Multiband aerial photography, Underwater photography, Infrared photography, Kelp inventories, Oil pollution, Water movement, Humboldt Bay (Calif), San Diego Bay (Calif), Rhodamine B, Rhodamine WT, Russian River (Calif), Austin Creek (Calif), Lake Tahoe (Calif), University of California (Davis).

Because problems of water quality management are diverse and complex, data must be utilized from many sources, ranging from synoptic aerial surveys by remote sensing to painstaking laboratory analysis. Remote sensing acquires information about an object which is not in intimate contact with the information-gathering device. Application of remote sensing techniques, principally photographic, to various marine and freshwater resources in California are described, including mapping of water movements, detection of general pollutants, detection of oil pollution, and inventory of kelp beds. Extensive information tabulated in the report includes photographic specifications for various applications, film-filter combinations for detection of rhodamine and pollutants in San Diego Bay, and relative utility of spectral bands in multiband detection of oil pollution. Benefits of remote sensing include: improved analysis and inventory of aquatic environments; more effective monitoring of selected water masses; comprehensive evaluation of aquatic communities and associated terrestrial resources; timely evaluation of pollutional sources and effects; and improved data acquisition on resource development for maximal benefit and minimal environmental damage. Image interpretation requires careful comparison with ground truth in a given area before meaningful extrapolations to new situations can be made. (See Vol 3, No 7, Field 5C, entry W70-02775). (Eichhorn-Wisconsin)
W70-03985

7C. Evaluation, Processing and Publication

CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO GROUNDWATER STATIONS,
Geological Survey, Washington, D.C. Office of Water Data Coordination.
For primary bibliographic entry see Field 02F.
W70-03658

BIBLIOGRAPHY OF THE GROUNDWATER RESOURCES OF NEW YORK THROUGH 1967,
Geological Survey, Albany, N.Y.
For primary bibliographic entry see Field 02F.
W70-03659

CATALOG OF INFORMATION ON WATER DATA, EDITION 1968 - INDEX TO AREAL INVESTIGATIONS AND MISCELLANEOUS ACTIVITIES,
Geological Survey, Washington, D.C. Office of Water Data Coordination.
For primary bibliographic entry see Field 02E.
W70-03663

COMMUNITIES OF OVER 1,000 POPULATION WITH WATER CONTAINING IN EXCESS OF 1,000 PPM OF TOTAL DISSOLVED SOLIDS,
Black and Veatch, Kansas City, Mo.
W. L. Patterson, and R. F. Banker.
Report available for sale by Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $0.70. Office of Saline Water Research and Development Progress Report No 462, Oct 1969. 47 p, 2 fig, 2 tab. OSW Contract No 14-01-0001-1777.

Descriptors: *Water supply, *Water quality, *Dissolved solids, Water resources, Water resources development, Water quality control, Population, Data collections, Hydrologic data.
Identifiers: Community development, Total dissolved solids.

A total of 420 communities in the United States of over 1,000 population with water supplies containing total dissolved solids in excess of 1,000 parts per million are listed. These communities in 29 states had a 1960 census population in excess of 2,770,000. These data can be used for improving water quality. (Carstea-USGS)
W70-03664

DEVELOPMENT OF MATHEMATICAL MODEL AND COMPUTER PROGRAM FOR OPTIMIZATION OF VERTICAL TUBE EVAPORATOR SALINE WATER PLANTS,
Houston Research Inst., Inc., Tex.
For primary bibliographic entry see Field 03A.
W70-03665

ESTIMATION OF THE PARAMETERS OF GUMBEL'S THIRD ASYMPTOTIC DISTRIBUTION BY DIFFERENT METHODS,
Michigan Univ., Ann Arbor; and Georgia Inst. of Tech., Atlanta.
Rolf A. Deininger, and James D. Westfield.
Water Resources Research, Vol 5, No 6, p 1238-1243, Dec 1969. 6 p, 1 fig, 5 ref.

Descriptors: *Statistical methods, *Probability, *Forecasting, *Droughts, Digital computers, Estimating, Least squares method, Frequency analysis.
Identifiers: Gumbel's method, Fibonacci search.

Estimation of the parameters of Gumbel's third asympototic distribution of the smallest value has been accomplished in the past by the following methods: (1) the method of moments; (2) using an order statistic on the characteristic drought; and (3) using the smallest observed drought. These three methods are compared with a fourth method that uses sequential least squares and a Fibonacci search. Based on estimates of the parameters of 44 rivers in the United States, it appears that methods 1, 2, and 3 do not give a satisfactory estimate of the smallest frought in a large number of cases. The method of using an order statistic was the least successful. The use of the least squares and Fibonacci search approach gave more acceptable estimates than the other methods. (Knapp-USGS)
W70-03674

AN ANALYSIS OF RUNS OF PRECIPITATION EVENTS,
North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering.
Edward H. Wiser.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 34, p 258-267, 1967. 10 p, 4 fig, 2 tab, 7 ref.

Descriptors: *Precipitation (Atmospheric), *Forecasting, *Statistical methods, *Markov processes, Stochastic processes, Probability, Monte Carlo method, Mathematical models.
Identifiers: Runs of data.

Simulation of precipitation records requires information about patterns of events. One useful characteristic is the number of runs of events or nonevents of any length. Equations presently available for standard models apply for an infinite series of draws, and data must be obtained carefully in order to fit the models. Exact equations are presented for the number of runs in a specified duration for a wide class of models, including the Bernoulli and Markov models as special cases. Equations are given for the number of runs of any length, for the total number of runs, and for the total number of events. The effects of analyzing runs over a limited time period is readily obtained. Examples are given of analyses of hourly events, showing the marked effect of persistence over short time periods. The inadequacy of standard models in describing the data is clearly demonstrated, and another model is used which more adequately accounts for the effect of persistence. (Knapp-USGS)
W70-03702

A MODEL FOR GENERATING SYNTHETIC SEQUENCES OF SHORT TIME-INTERVAL RAINFALL DEPTHS,
Massachusetts Inst. of Tech., Cambridge.
For primary bibliographic entry see Field 02B.
W70-03703

A MOSAIC TECHNIQUE FOR GENERATING THE DAILY PATTERN WITHIN A SYNTHETIC FLOW SEQUENCE,
Welsh Coll. of Advanced Technology, Cardiff; and Water Research Association, Medmenham (England).
For primary bibliographic entry see Field 02A.
W70-03704

ON THE FLUCTUATION OF WATER RESOURCES,
Kyoto Univ. (Japan). Disasters Prevention Research Inst.
For primary bibliographic entry see Field 02A.
W70-03705

STOCHASTIC STUDY OF CHANNEL DISTRIBUTION IN RIVER BASINS,
Kyoto Univ. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-03707

STATISTICAL CONSIDERATION IN RIVER MORPHOLOGY,
Institute for Water Resources, Belgrade (Yugoslavia).
For primary bibliographic entry see Field 02E.
W70-03708

SOME PROPOSALS OF THE STOCHASTIC METHOD OF FORECASTING FOR DEPOSITS IN RESERVOIRS,
Osaka Univ. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 02J.
W70-03709

ADAPTIVE FILTERS FOR TREND EXTRAPOLATION OF RUNOFF RECORDS,
Deutsche Akademie der Wissenschaften zu Berlin (East Germany). Inst. for Physical Hydrography.
Otto Czepa.
French resume included. Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 50, p 384-388, 1967. 5 p, 1 fig, 1 ref.

Descriptors: *Streamflow forecasting, *Time series analysis, Statistical methods, Probability, Data processing, Frequency analysis.
Identifiers: Data filters, Moving average methods.

To estimate the oscillatory fluctuations of a time series with a given constant period (e.g. the seasonal with a period of P = 12 mon) we would want to limit frequencies. Exponentially weighted moving averages are filters which will give a reasonably good approximation for this purpose. The gain factor of weighted moving average filters and recursion formulas for numerical smoothing and extrapolation are discussed. (Knapp-USGS)
W70-03710

A METHOD FOR STATISTICAL EVALUATION OF WEATHER MODIFICATION AT THE RIVER FLOW CONTROL LEVEL,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 03B.
W70-03848

ELECTRICAL ANALOGUES AND DIGITAL COMPUTERS FOR ESTIMATING UNSATURATED WATER FLOW IN SOILS,
Agricultural Research Service, Fort Collins, Colo. Soil and Water Conservation Research Div.
For primary bibliographic entry see Field 02G.
W70-03882

DETERMINING AND MAPPING THE AVERAGE HYDROLOGIC RESPONSE OF EASTERN UNITED STATES,
Franklin Coll. of Arts and Sciences, Athens, Ga.
James F. Woodruff, and John D. Hewlett.
Available from the Clearinghouse as PB-189 524, $3.00 in paper copy, $0.65 in microfiche. Completion Report, Franklin College of Arts and Sciences and School of Forest Resources, University of Georgia, Athens, Georgia. Dec 1969. 33 p. OWRR Project A-013-GA.

Descriptors: *Hydrologic mapping, *Hydrologic properties, *Direct runoff, *Synoptic analysis, *Hypsometric analysis, *Terrain analysis, Streamflow, Storm runoff, Base flow, Peak flow, Hydrologic data, Hydrologic cycle, Hydrograph analysis, Regression analysis, Watersheds, Precipitation data, Gaging stations, Topography, Maps.

An attempt was made to predict the average annual basin hydrologic response of ungaged watersheds in the East by regression against 15 planimetric, hypsometric and land use factors available on 90 test basins varying in size from 2 to 100 square miles. Using topographic, hydrologic, and precipitation data available regression coefficients developed relating response to basin factors proved entirely non-significant Studies revealed that the part of a basin's annual precipitation that will become flood waters cannot be predicted from available morphometric data on basins because response is controlled chiefly by porous mantle factors not measurable on normal data sources A hydrologic response map of Eastern United States plotted directly from streamflow and precipitation records for 201 basins ranging up to 200 square miles indicated that the average basin response corresponded with the main geological provinces of the East. By revealing specific regions of high flood-producing potential, the map proves that the synoptic response ratio is a meaningful parameter. The authors suggest that the best way to map response may be to measure precipitation and streamflow by cheap, short-term methods traditionally regected as uneconomical. The report contains 16 references. (Conway-Georgia Tech)
W70-04008

COMPUTER STUDIES OF FINITE-AMPLITUDE WATER WAVES,
Stanford Univ., Calif. Dept. of Civil Engineering.
Robert K. C. Chan, Robert L. Street, and Theodor Strelkoff.
Available from the Clearinghouse as PB-189 522, $3.00 in paper copy, $0.65 in microfiche. Technical Report No 104, June, 1969. 97 p, 4 tab, 39 fig, 36 ref. ONR Contract Nonr 225 (71) NR 062-320 and National Science Foundation Grant GK 2506. OWRR Project B-037-CAL.

Descriptors: *Waves (Water), *Digital computer.
Identifiers: *Solitary wave, *Finite differences.

Two numerical techniques are utilized to study the motion of two-dimensional, finite-amplitude water waves by using an electronic digital computer. The nonlinear properties of water waves are of primary interest. The first part of the work introduces the Stanford-University-Modified MAC (SUMMAC) code which is proposed as a valid tool for analyzing incompressible, viscous flows with a free surface under transient conditions. The method is applied to the study of the solitary wave run-up on a vertical wall. The results are compared with the available experimental data and give a much better prediction of the wave run-up than the existing analytic theory. In the second part, Newton's process of successive corrections is applied to solve steady-state potential flows with free surface and gravity. A specific application to the analysis of solitary waves is made and all the wave characteristics are in excellent agreement with experiments.
W70-04009

08. ENGINEERING WORKS

8A. Structures

TUNNELLING METHODS IN HUNGARY,
Technical Univ., of Budapest (Hungary).
C. J. Szechy.
Tunnels Tunnelling, Vol 1, No 3, p 131-133, Sept-Oct, 1969. 3 p, 7 fig.

Descriptors: *Tunnel construction, *Tunneling, Tunnel linings, Tunnels, Geologic formations, Geology, Foreign construction, Alinements, Waterproofing, *Engineering geology, Geologic investigations, Underground structures.
Identifiers: Tunnel inverts, Tunnel supports, Hungary, Budapest (Hungary), *Subways, Subsurface openings.

While the general location of a tunnel is governed by direct traffic and transportation demands, the exact location and method of construction are subject to geological circumstances. How far the geological picture, combined with the possibilities of a relatively free access from the surface, may influence the construction method is illustrated with a description of the special construction features

used in building the east-west line of the new Budapest underground railway. A wide range of tunneling methods was used. Special combined techniques were necessary in constructing deep-level stations, shield-chambers, ventilation shafts, and other adjoining underground facilities. (USBR)
W70-03790

DISTRIBUTION OF CONCENTRATED LOADS ON ORTHOTROPIC BRIDGE DECKS,
Dundee Univ. (Scotland).
A. R. Cusens, and R. P. Pama.
Struct Eng, Vol 47, No 9, p 377-385, Sept 1969. 9 p, 11 fig, 10 ref.

Descriptors: *Bridges, Plates, Slabs, *Load distribution, Computer programs, Equations, Mathematical analysis, Series (Mathematics), Stress distribution, *Bridge design, Structural analysis, Structural engineering, Experimental data.
Identifiers: *Orthotropic bridges, *Concentrated loading, Computeraided design, Comparative studies, *Bridge decks.

A general method based on a series solution of the orthotropic plate equation is presented for analyzing the distribution of concentrated loads in right orthotropic bridge decks. The method is compared to the widely adopted Guyon-Massonnet quasi-slab analysis devised before digital computers were used in structural design and necessarily embodied a number of approximations and limitations. The method is valid over a wider range than the Guyon-Massonnet analysis, and experimental evidence indicates better accuracy, particularly in computing longitudinal moments.
W70-03798

DRAINAGE MASTER PLAN FOR THE CITY OF FORT WORTH PUBLIC WORKS DEPARTMENT, STORM DRAINAGE CRITERIA AND DESIGN MANUAL.
Knowlton-Ratliff-English, Fort Worth, Tex.

Fort Worth, Knowlton-Ratliff-English, Consulting Engineers, 1967. 74 p, 25 tab, 63 fig, 14 ref.

Descriptors: *Drainage engineering, *Design criteria, *Drainage programs, *Drainage practices, *Storm runoff, *Surface drainage, *Storm drains, *Flood control, Rainfall-runoff relationships, Hydrology, Hydraulic structures, Hydraulics, Intakes, Open channels, Storage, Culverts.
Identifiers: *Fort Worth, *Drainage master plan, *Gutter flows, Nomographs, Coding.

The purpose of this drainage manual is to establish standard criteria, principles, procedures, and practices for the design of storm drainage facilities within the City of Fort Worth, Texas. The manual constitutes the first phase of the development of a master plan for storm drainage to guide the design and construction of storm sewers and channels in the City and its anticipated growth area. The manual is presented in nine sections that give logical development to the solution of storm drainage problems. The introductory section covers definitions and abbreviations, code designation of drainage system elements and the degree of protection afforded. Other sections cover: determination of design discharge; flow in gutters; storm drain inlets; flow in storm drains; closed storm drainage systems; design of open channels; design of culverts; and appendices which include a glossary of terms, bibliography, and tables and suggested computation forms. Many nomographs are included to facilitate solutions to various engineering computations involved in drainage design. Tables are included presenting suggested values of design parameters for various conditions and circumstances. Relationships between rainfall and runoff, and the use of the Rational and Unit Hydrograph methods of runoff computation are included. (See also W70-03815 thru W70-03818). (Poertner-Chicago)
W70-03814

SECTION I, INTRODUCTION; SECTION II, DETERMINATION OF DESIGN DISCHARGE; SECTION IX, APPENDIX.
Knowlton-Ratliff-English, Fort Worth, Tex.

In: Drainage Master Plan for the City of Fort Worth Public Works Department, Storm Drainage Criteria and Design Manual, Knowlton-Ratliff-English Consulting Engineers, Fort Worth, 1967. 19 p, 9 tab, 5 fig.

Descriptors: *Drainage engineering, *Design criteria, *Watersheds, *Time of concentration, *Runoff coefficient, *Rainfall-runoff relationships, *Hydrology, Surface drainage, Storm runoff, Bibliographies.
Identifiers: *Fort Worth, *Drainage master plan, *Glossary of drainage terms, Drainage computation forms.

Section I is an introduction explaining the purpose and arrangement of the manual. Division of the urban area into defined watersheds, drainage areas, and drainage sub-areas and a system of coding these elements of the drainage system are also presented. Section II, entitled 'Determination of Design Discharge sets forth six conditions which should govern the design of a storm drainage system. This section also treats methods for determining the amounts and rates of runoff using the Rational Method and the Unit Hydrograph Method. The Rational Method is specified for watershed areas up to 1,000 acres. Above this area, computations using both methods are specified and the greater discharge is to be used for design of the elements of the system. The use of planimetric-topographic maps of the area is recommended for determining the size and shape of watersheds. Typical runoff coefficients and graphs of rainfall intensity vs. duration and frequency are included as being representative of the Fort Worth area. A nomograph for computing 'time of concentration' is presented. Section IX constitutes an appendix which includes a glossary of terms, bibliography, and forms for use in making engineering computations. (See W70-03814). (Poertner-Chicago)
W70-03815

SECTION III, FLOW IN GUTTERS; SECTION IV, STORM DRAIN INLETS.
Knowlton-Ratliff-English, Fort Worth, Tex.

In: Drainage Master Plan for the City of Fort Worth Public Works Department, Storm Drainage Criteria and Design Manual, Knowlton-Ratliff-English, Consulting Engineers, Fort Worth, 1967. 56 p, 38 fig.

Descriptors: *Gutter flows, *Intakes, *Drainage engineering, *Storm runoff, *Surface drainage, *Hydraulic structures, Hydraulics, Drainage engineering, Design criteria, Drainage practices, Storm drains.
Identifiers: *Fort Worth, *Gutter flows, *Street flows, *Inlets, *Inlet design, *Inlet capacity, Nomographs, Drainage design computations, Computation aids.

Section III presents information, a nomograph, and curves to facilitate making computations required in designing the various hydraulic properties of street gutters and roadway ditches. The nomograph and curves greatly simplify the otherwise complicated solutions for depth of flow of drainage runoff in gutters and the lateral spread of the water into traffic lanes. The nomograph and figures, which are graphical solutions of Manning's Equation for uniform flow, are developed for streets of different widths and roughness coefficients, and for streets with straight cross slopes and others with various size parabolic crowns. Section IV presents sketches, criteria and examples to illustrate design procedures, standards and techniques for determining hydraulic capacities and required dimensions of storm drain inlets. Three major classifications of inlets are treated; namely, (1) inlets in sumps, (2) inlets on grade without gutter depression, and (3) inlets on grade with gutter depression. Curves and computation forms are included to simplify solutions of the complicated mathematical formulas. (See W70-03814). (Poertner-Chicago)
W70-03816

SECTION V, FLOW IN STORM DRAINS AND THEIR APPURTENANCES; SECTION VI, DESIGN OF CLOSED STORM DRAINAGE SYSTEM; SECTION VII, DESIGN OF OPEN CHANNELS.
Knowlton-Ratliff-English, Fort Worth, Tex.

In: Drainage Master Plan for the City of Fort Worth Public Works Department, Storm Drainage Criteria and Design Manual, Knowlton-Ratliff-English, Consulting Engineers, Fort Worth, 1967. 29 p, 7 tab, 6 fig.

Descriptors: *Drainage engineering, *Design criteria, *Hydraulic design, *Pipe flow, *Closed conduit flow, *Storm drains, *Open channel flow, Hydraulics, Channel flow, Concrete pipes, Metal pipes, Hydraulic structures, Drainage systems, Mannings equation, Joints, Head loss, Hydraulic gradient, Roughness coefficient.
Identifiers: *Fort Worth, *Drainage systems design, Drainage master plan.

Section V presents criteria, procedures, formulas and roughness coefficients for use in designing the hydraulic elements of storm drains and appurtenances to storm drainage systems. A minimum mean flow velocity of 2.5 ft. per sec. is specified, as are minimum grades for various sizes of concrete pipe and corrugated metal pipe. Charts for facilitating hydraulic computations based upon the Continuity Equation and Manning Formula are included. Tables of design coefficients are included for calculating head losses at inlets, manholes, junctions, bends, obstructions and size changes. The hydraulic grade line is required to be 2 ft. or more below ground or streets. Section VI presents the overall drainage system design procedure, step-by-step, applying the criteria, techniques, formulas, coefficients and charts presented in the preceding sections of the manual. Section VII presented criteria, formulas, roughness coefficients and procedures for designing the hydraulic elements of lined and unlined open channels, rectangular and trapezoidal in cross-section, and natural ditches. The Manning Formula is the basis of design. (See W70-03814). (Poertner-Chicago)
W70-03817

SECTION VIII, DESIGN OF CULVERTS.
Knowlton-Ratliff-English, Fort Worth, Tex.

In: Drainage Master Plan for the City of Fort Worth Public Works Department, Storm Drainage Criteria and Design Manual, Knowlton-Ratliff-English, Consulting Engineers, Fort Worth, 1967. 34 p, 3 tab, 14 fig.

Descriptors: *Culverts, *Drainage engineering, *Drains, *Outlet works, *Hydraulic design, *Storm drains, *Storm runoff, *Surface drainage, *Design criteria, Hydraulic structures, Pipes, Roads, Hydraulics, Drainage practices, Concrete pipes, Metal pipes, Head loss, Roughness coefficient.
Identifiers: *Fort Worth, *Highway culvert design, *Highway drainage, Box culverts, Pipe culverts, Culvert sizing, Nomographs.

Section VIII defines the functions of drainage culverts, presents design criteria, establishes the method of flow determination and sets forth design formulas, coefficients and procedures for sizing various types of culverts. It is specified that the quantity of flow shall be determined by the Rational Method or the Unit Hydrograph Method. All designs are to be based on a 50 year storm frequency. 'Entrance loss' coefficients are specified for culverts constructed of concrete pipe, corrugated metal pipe and concrete box-sections--all with varying headwall end wall, and wingwall designs. Formulas are specified for hydraulic computations under various culvert flow depths and various degrees of submergence at the entrance and inlet.

Seven examples of culvert sizing computations are presented. Nomographs are included for use in simplifying computations associated with the hydraulic design of culverts. Their use is illustrated in conjunction with the presentation of the design examples. (See W70-03814). (Poertner-Chicago)
W70-03818

8B. Hydraulics

NUMERICAL SIMULATION OF WITHDRAWAL FROM A STRATIFIED RESERVOIR,
Oregon State Univ., Corvallis, Oreg.
H. T. Mercier, M. D. Terry, and L. S. Slotta.
ASCE National Water Resources Engr Meeting, Memphis, Tenn, Jan 26-30, 1970. 16 p, 5 fig.

Descriptors: *Mathematical models, *Density currents, Density stratification, Numerical analysis, Computer models, Reservoirs, Density.

Modifications are presented to the MAC method for the flow of a non-homogeneous, viscous, incompressible fluid and summaries are compiled for numerical investigations of withdrawal from a density stratified reservoir. The equations of motion were developed from the system of the partial differential equations of incompressibility, continuity and the Navier-Stokes equation. Those equations were solved numerically by finite difference techniques. The research procedure was to simulate a reservoir and investigate the effects of viscosity variation, density stratification, and the presence of a submerged ridge on the flow pattern. Both the continuous and the two-layered models were used. The computation was made on a CDC 6600 computer. (Novotny-Vanderbilt)
W70-03716

BEHAVIOR OF BUOYANT JET IN CALM FLUID,
Hydraulics Research Station, Wallingford (England).
Habib O. Anwar.
Journal of the Hydraulics Division, Proceedings of ASCE, Vol 95, No HY4, Proc Paper 6688, p 1289-1303, July 1969. 10 fig, 13 ref.

Descriptors: *Jets, *Outlet, *Hydraulics models, *Mixing, *Buoyancy, Diffusion, Turbulence.

The investigation studied the turbulent mixing that occurs when sewage is discharged into the sea from a deeply submerged outlet, which is the case when the buoyancy forces dominate the largest part of the rising plume. The investigation was carried out by discharging freshwater from circular nozzles of 1/2 inch and 1 inch diameter, into a quiescent ambient fluid of greater density. The ambient fluid was salt solution of uniform density. The density at points in the plume was determined by measuring the concentration of the solution using an electrical conductivity probe. Conclusions were (1) it was found that the density distribution across the plume is almost Gaussian, (2) the motion in the rising plume is similar to convection over a heated source when the nozzle densimetric Froude number is low, and (3) it has been found that the results are similar to those given by Fan and Abraham and also satisfactory agreement has been found between calculations and experimental results. These calculations were made neglecting initial jet momentum and treating the plume as purely buoyant. Comparison with results of work by Frenkel and Cummings proved unsatisfactory. (Guerrero-Vanderbilt)
W70-03724

DIFFUSION AND ENTRAINMENT IN TWO-LAYER FLOW,
Norges Tekniske Hoegskole, Trondheim. River and Harbor Lab.
T. Carstens.
Journal of the Waterways and Harbors Division, Proceedings of the ASCE, Vol 96, No WW1, Proc Paper 7081, p 97-104, Feb 1970.

Descriptors: *Water pollution, *Salinity, *Turbulence, *Diffusion, Harbors.
Identifiers: *Entrainment.

A layer of freshwater overriding a pool of seawater may extract salt from the pool of two mechanisms: (1) Diffusion; and (2) entrainment. While diffusion is a two-way transport by which equal volumes are exchanging places, entrainment is a one-way, advectival type of transport. The rates of the two vertical transports depend on the turbulence in the surface layer and in the pool. The more turbulent water mass will erode the less turbulent one and entrain it. On two occasions fluxes of water and salt past two vertical cross sections of the surface layer were measured in a fjord. In one case there was only about 10% entrainment between the two sections, in the other about 100%. (Guerrero-Vanderbilt)
W70-03728

UNIFIED VIEW OF DIFFUSION AND DISPERSION,
Illinois Univ., Urbana. Dept. of Civil Engineering.
Edward R. Holley.
Journal of the Hydraulics Division, Proceedings of the ASCE, Vol 95, No HY2, Proc Paper 6462, p 621-631, Mar 1969.

Descriptors: *Dispersion, *Diffusion, *Convection, Mixing.
Identifiers: Diffusion coefficient, Dispersion coefficient, Longitudinal dispersion.

The similarities among the various types of diffusion and dispersion are discussed. Diffusion and dispersion are basically convective transport mechanisms. The method chosen for representing the convection in a mass balance equation is the determining factor in deciding whether diffusion or dispersion must be included in the conservation equation for a given flow. This principle is illustrated for molecular diffusion, turbulent diffusion, and longitudinal dispersion. In a given flow, the relative importance of diffusion or dispersion in different transport problems depends on the steepness of the concentration gradient. It is proposed that the term 'diffusion' be reserved for transport that is associated primarily with time-averaged velocity fluctuations and that 'dispersion' be used for transport associated primarily with the spatial average of velocity variations. (Guerrero-Vanderbilt)
W70-03729

MOTION OF TWO DIMENSIONAL STARTING PLUME,
Waterloo Univ. (Ontario). Dept. of Mechanical Engineering; and New South Wales Univ., Kensington (Australia).
Gee Tsang, and Ian R. Wood.
Journal of the Engineering Mechanics Division, Proceedings of the ASCE, Vol 94, No EM6, Proc Paper 6321, p 1547-1561, Dec 1968. 10 ref, 6 fig.

Descriptors: *Dimensional analysis, *Density, *Stratified flow, Velocity, Buoyancy.
Identifiers: *Plumes.

A motion study was made of a two dimensional starting plume with the emphasis on looking for a stream function for the surrounding fluid. Dimensional analysis is used to show that the shape and velocity distribution of the plume when expressed in a dimensionless form is a constant and that the ratio of the velocity of the leading edge to the third power of the flux of density difference times the gravitational constant from the line source is a constant, C. Experiments in which velocities were measured with neutrally buoyant particles were carried out showing that the plume consisted of a cylindrical cap and a wedge shaped tail and that the ratio of the radius of the cylinder to the total length of the plume, n, was approximately one third. The value of C was 1.20 with a standard deviation of 0.03. A model in which the cap is treated as a solid moving cylinder was used to obtain a relationship between C and the rate of spread. A distribution of doublets, sources, and sinks was found which defined the flow field outside the vorticity-containing region. (Guerrero-Vanderbilt)
W70-03731

JET INDUCED CIRCULATION AND DIFFUSION,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
Constantin Iamandi, and Hunter Rouse.
Journal of the Hydraulics Division, ASCE, Vol 95, No HY2, Proc Paper 6446, p 589-601, Mar 1969. 8 fig, 6 ref.

Descriptors: *Bubbles, *Diffusion, *Circulation, *Jets, Turbulent flow.

Patterns of mean flow and turbulence for various jet boundary configurations were determined. Tests were conducted in an air duct to determine the patterns of mean flow and turbulence produced by a jet emerging along an edge of the duct parallel to one of the duct walls. The parameters that have been varied include the relative proportions of the duct and a nondimensional grouping of the momentum characteristics of the jet. It has been concluded that: (1) Submerged jets provide an alternative (and even more adaptable) means of maintaining the pattern of flow for which a bubble screen is often utilized; (2) the generalized characteristics of the measured mean-flow and turbulence fields are subject to use in design over a considerable range of scales and operational conditions; and (3) until such time as similar studies have been carried out for bubble screens, an approximate method is at hand for comparing their effectiveness in terms of the information for jets presented herein. (Guerrero-Vanderbilt)
W70-03734

WATER-HAMMER ATTENUATION WITH A TAPERED LINE,
Youngstown State Univ., Ohio; Carnegie-Mellon Univ., Pittsburgh, Pa.
F. J. Tarantine, and W. T. Rouleau.
Trans Amer Soc Mech Eng, Ser D--J Basic Eng, Vol 91, No 3, p 341-352, Sept 1969. 12 p, 15 fig, 11 ref, 3 disc.

Descriptors: *Water hammer, Surges, Hydraulics, *Attenuation, *Valves, Pressure, Theoretical analysis, Experimental data, *Closing, Time, Sonic waves, Velocity, Mathematical models, *Tapers, Vibrations, Reynolds number.
Identifiers: Surge waves, Test results, Wave propagation.

Pressure attenuation that can be obtained through application of a rigid tapered section located immediately upstream of a quick-closing valve or other surge-generating device was investigated. The model used was an inviscid liquid flowing through a rigid, tapered tube terminated by either a very long, uniform line or a finite-length line and reservoir. An outline of a theoretical method for solving the problem and some practical solutions are presented. A description of the experimental procedure used to validate the analytical approach and assumptions used in the analysis are given. Results of experimental determinations are compared with theoretical water-hammer calculations. Inserting a tapered section at the valve end of a long, uniform line delayed the normal pressure rise associated with water hammer. Because of the time delay, a tapered section at the valve can reduce effectively the pressure surge resulting from quick closing-reopening or opening-reclosing of the valve. (USBR)
W70-03785

8C. Hydraulic Machinery

UNIT SPACING OF HYDROELECTRIC MACHINES,
English Electric Co. Ltd., Whetstone.
E. G. Taylor.
Water Power, Vol 21, No 10, p 377-380, Oct 1969. 4 p, 5 fig, 6 ref.

Descriptors: *Hydroelectric plants, *Structural design, Velocity, Dimensions, *Francis turbines, *Hydraulic turbines, Pressure head, Specific speed, *Electric generators, Graphical analysis, Hydroelectric power, Turbine runners, Foreign research, Design, Spiral cases, Stators, *Powerhouses.
Identifiers: *Spacing, Great Britain, Turbine head covers.

Designing a hydroelectric installation requires preliminary information concerning the generator and turbine. Some problems arising are: (1) the required value of fly-wheel effect--the energy constant and related speed rise and pressure rise; (2) the ability of turbine head cover to pass in one piece through the generator stator bore; and (3) dimensions of the generator air housing and spiral casing to determine whether the generator or the spiral casing dimensions fix the unit spacing. Equations are expressed as curves so that by knowing the power required and the rated head of the unit, generator and turbine dimensions and unit spacing can be solved graphically. The graphs given were derived for Francis turbines; similar graphs can be constructed for other types of turbines by using this method. From the various graphs, generator and turbine dimensions are derived; applying these dimensions to a unit spacing graph provides dimensions for the hydroelectric powerplant design. (USBR)
W70-03783

8D. Soil Mechanics

INFILTRATION INDUCED SOIL INSTABILITIES,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02G.
W70-03648

COMPARISON OF PILE LOAD-TEST-SKIN-FRICTION VALUES AND LABORATORY STRENGTH TESTS,
Saskatchewan Univ., Saskatoon; and Sir George Williams Univ., Montreal (Quebec).
W. G. Watt, P. J. Kurfurst, and Z. P. Zeman.
Can Geotech J, Vol 6, No 3, p 339-352, Aug 1969. 14 p, 11 fig, 1 tab, 7 ref.

Descriptors: *Piles (Foundations), Pile friction, Foreign research, Pile bearing capacities, Pile foundations, Concrete piles, Direct shear, Skin friction, *Laboratory tests, Van shear tests, Shear strength, Soil tests, Soil engineering, Soil mechanics, Test procedures, *Friction piles, *Field tests.
Identifiers: *Pile tests, *Cast-in-place piles, Loading tests, Test piles, *Comparative studies, Saskatchewan (Canada), In situ tests.

Three full-scale bored, cast-in-place concrete piles constructed to give no-tip resistance were loaded to failure using the equilibrium method of loading. Each pile was 24 in. in diameter, but of different length, stopping in turn in strata of partly saturated highly plastic clay, saturated silty clay, and till. Ultimate skin friction values were calculated and compared to direct shear tests and laboratory and field vane tests, giving values of undrained shear strength. Large variations were present in shear strength results even at the same depth in adjacent holes. Comparison of vane tests on soil samples and on the surface of the bored hole showed the disturbance caused by drilling to be negligible for these soils. Results from an interfacial friction device lowered into the hole indicated that the skin friction increased with lateral stress and that the lateral pressure on the concreted piles at the time of testing was less than 10 psi. (USBR)
W70-03781

PRE-EQUILIBRIUM OBSERVATIONS ON THE RECONSTRUCTED FLAGSTAFF GULLY DAM,
Commonwealth Scientific and Industrial Research Organization, Melbourne (Australia).
O. G. Ingles, J. G. Lang, and B. G. Richards.
Res Pap No 116, Symp Earth Rockfill Dams, Punjab, India, Vol 1, p 162-170, Nov 1968. 9 p, 12 fig, 2 tab, 11 ref.

Descriptors: *Earth dams, *Dam failure, Dams, Embankments, *Leaching, Fills, Pore pressure, Soil chemical properties, Soil engineering, Soil mechanics, *Soil stability, Phreatic lines, Foreign research, Rockfill dams, Soluble salts, Piezometers, Seepage, Clays, Dispersion, Zoned embankments, Montmorillonite, Permeability.
Identifiers: Exchangeable sodium percentage, *Piping (Erosion), Flagstaff Gully Dam (Tasmania), Australia, Peptization.

Deflocculation of the sodium-rich clay core may have contributed substantially to the piping failure of Flagstaff Gully Dam in Tasmania, shortly after first filling. Conditions for such a failure exist when water of low salinity flows through a clay soil having a high exchangeable sodium percentage at a velocity exceeding the swelling rate of the soil, resulting in salt leaching, deflocculation, and removal of soil at an ever-accelerating rate. When flow velocity is less than the swelling rate, salt leaching occurs at an ever-diminishing rate, flow channels seal off gradually by swelling, and the soil is progressively stabilized against seepage. Conclusions from observations of installations to monitor the reconstructed embankment of Flagstaff Gully Dam are presented. Initial installations showed that the potential hazard of clay deflocculation was present and could become acute in a short time. Additional installations showed that a low rate of permeability precluded an immediate hazard and ensured long-term core stability. Dissipation of construction pore pressures is extremely slow and final equilibrium will not be reached for at least 15 yr after construction. (USBR)
W70-03782

ON THE EFFECTIVENESS OF SAND DRAINS,
Harvard Univ., Cambridge, Mass.
L. Casagrande, and S. Poulos.
Can Geotech J, Vol 6, No 3, p 287-326, Aug 1969. 40 p, 39 fig, 22 ref.

Descriptors: Drains, Drainage wells, Soil mechanics, Drainage, Soil physical properties, Soil properties, Soil strength, Consolidation, *Foundations, Peat, Relief wells, Effects, Settlement (Structural), Clays, Organic soils, Shear strength, Permeability, Pore pressure, Bibliographies, *Vertical drains, Field tests, *Sand drains.
Identifiers: Drain holes, Drain spacing, Soil characteristics, In situ tests, Comparative studies, Secondary consolidation, Compressible soils.

Detrimental effects of driving sand drains in sensitive soils are discussed. Several case records of the behavior of embankments on such soils are analyzed. If careful foundation investigation indicates the desirability of increasing the rate of primary consolidation, non-displacement sand drains should be installed with minimum disturbance to the surrounding soil. Sand drains of any type are of little or no value in soils exhibiting substantial secondary settlements. Proper design of nondisplacement sand drains systems must be based on a careful study of an adequate number of undisturbed soil specimens in the partly dried condition and on in situ horizontal permeability tests, in addition to the classification, strength, and consolidation tests normally performed. (USBR)
W70-03784

MINIMIZING NUCLEAR SOIL DENSITY AND MOISTURE CONTENT GAGE ERRORS,
North Carolina State Univ., Raleigh.
For primary bibliographic entry see Field 07B.
W70-03787

APPLICATION OF PORE PRESSURE MEASUREMENTS TO SHEAR STRENGTH OF COHESIVE SOILS,
Bureau of Reclamation, Denver, Colo.
For primary bibliographic entry see Field 07B.
W70-03788

PORE PRESSURE MEASUREMENTS IN THE FIELD AND IN THE LABORATORY, PART I AND PART II,
Imperial Coll. of Science and Technology, London (England).
P. R. Vaughan, A. W. Bishop, and G. E. Green.
Pap, 7th Int Conf, Int Soc Soil Mech Found Eng, Mexico, Aug 1969. 18 p, 68 ref.

Descriptors: *Pore pressure, *Pore water pressures, Field tests, Field data, *Pore air pressures, Bibliographies, *Measurement, Soil mechanics, Measuring instruments, Laboratory tests, Porous tube piezometers, Filter stones, Negative pore pressure, Instrumentation, Piezometers, Saturated soils, Pressure sensors, Soil engineering, Soil tests, Foreign research.
Identifiers: Pressure transducers, Unsaturated soils, Undrained tests, Triaxial tests, Drained tests, Great Britain.

Principles involved and methods used for making field measurements of pore pressure in saturated and unsaturated soils are discussed. Topics are suggested on which discussion and additional data would be useful for interpreting and assessing accuracy and long-term reliability of field measuring systems. Three classes of laboratory problems in measuring pore pressures are discussed: (1) undrained tests--pore pressure is uniform throughout the sample, but varies with time; (2) consolidation tests and pore pressure dissipation tests--controlled boundary drainage results in pore pressure gradients in the sample; and (3) model tests--undrained pore pressure is nonuniform. (USBR)
W70-03797

8E. Rock Mechanics and Geology

GEOLOGY OF FLAMING GORGE DAM AND RESERVOIR,
Bureau of Reclamation, Salt Lake City, Utah.
J. Neil Murdock.
Intermount Ass Geol, 16th Annu Field Conf, p 23-32, 1969. 10 p, 3 fig, 4 ref.

Descriptors: *Engineering geology, *Geologic investigations, Drill holes, Dam foundations, *Damsites, Concrete dams, Arch dams, Shales, *Foundation investigations, Abutments, Seepage, Keyways, Diversion tunnels, Cutoffs, Anchors, Grouting, Grout curtains, Landslides, Reservoirs, Reservoir sites, Rock foundations.
Identifiers: Percolation tests, Seepage control, Flaming Gorge Dam (Utah), Flaming Gorge Reservoir (Utah).

The geology of Flaming Gorge Dam and Reservoir is described and some related problems in design and construction are discussed. Preliminary exploration indicated that the general quality of the rock was excellent, but because of faults, joints, and clay seams, extensive geological investigations and mapping were required to obtain sufficient information for the final design of the dam and appurtenant structures. Diamond drill coring, seismic studies, and drill hole percolation tests were performed. Some problems anticipated were seepage, extra excavation to reach sound rock, and pinning of certain areas to prevent possible movement. The seepage problem was relatively minor, requiring extension of the main cutoff grout curtain deeper

into both abutments. Abutment rock was pinned to assure stability and to prevent rockfalls. Shale seams in the keyway areas were treated by placing concrete cutoff walls in the shale beds at the heel and toe of the dam. As the reservoir was filled for the first time, several small slumps occurred in slopes along the sides of the reservoirs. One movement of a large block of rock presented a potential hazard to boaters and is under careful observation. At the present time, the landslide areas are not considered hazardous. (USBR)
W70-03791

THE PROBLEMS ON TUNNEL EXPLORATION,
Bureau of Reclamation, Denver, Colo.
Charles E. Hall.
Proc 7th Annu Eng Geol Soils Eng Symp, p 3-8, Moscow, Idaho, Apr 1969. 6 p.

Descriptors: *Engineering geology, Geologic investigations, Subsurface investigations, *Tunnels, Tunnel construction, Tunneling machines, Bids, Tunnel design, *Geologic mapping, Geologic control, Geophysics, Contract administration, Claims (Contracts), Exploration, Reconnaissance surveys, Helicopters, Alinements.
Identifiers: Geologic defects, Geophysical prospecting, Seismic refraction.

In recent tunnel projects, design engineers have been requesting detailed geologic information and interpretation of the effects of geologic structure on construction. Bureau of Reclamation programs now call for surface geologic mapping on a scale of 2000 ft to the inch for 4 or 5 mi either side of the alinement, and detailed mapping along the alinement on a scale of 400 ft to the inch. Field mapping is best performed on aerial photographs and then projected to either a planimetric base or a topographic base. Concentrating on engineering rock properties to place the engineering characteristics of a particular rock directly on the geologic map is most desirable, rather than to concentrate on classical geologic properties and names of formations. Detailed alinement mapping is followed by geophysical investigations and confirmed by drilling wherever time, money, and access permit. Access problems on tunnel investigations in relatively inaccessible areas are discussed, and experiences with helicopters are cited. When exploration and design are completed, there is the problem of what to put into the gidding documents for potential bidders; a private opinion is given that owners should provide the factual information and the geological interpretations upon which the design is based. (USBR)
W70-03792

ROCK CUTTING RESEARCH FOR THE DESIGN AND OPERATION OF TUNNELLING MACHINES,
Newcastle-upon-Tyne Univ. (England).
F. F. Roxborough.
Tunnels Tunnelling, Vol 1, No 3, p 125-128, Sept-Oct 1969. 4 p, 8 fig, 8 ref.

Descriptors: Tunnel construction, Rock mechanics, Mining engineering, *Rock excavation, Construction, *Tunneling machines, Experimental data, Compressive strength, Mechanical properties, Research and development, Temperature, Water cooling, *Foreign research, Test procedures, Cutting, Instrumentation, Rocks.
Identifiers: Rock density, Great Britain, Tool design, Test results.

The need for machines capable of driving tunnels in rock has long been recognized by mining engineers. The ease with which coal shearing machines are able to cut through rock intrusions encouraged engineers to explore the possibility of applying the same milling principle to rock cutting machines. Most mechanical rock cutting techniques require the penetration of a wedge into a rock surface, chipping fragments having volumes exceeding that of the tool or wedge. Rock cutting research has lagged behind machine development and application. The untenable situation exists in which machines are being further developed without any appreciation of rock cutting mechanics. Knowledge of the performance characteristics of a cutting tool in rock is essential in designing an efficient cutting system. The University of Newcastle upon Tyne, Great Britain, is undertaking research into the mechanical durability of tool materials for operation in a wide range of rock types from quartz-free limestones to granite. A simple method for assessing the machineability of rock is presented. The principles of full face cutting and of peripheral drum cutting are discussed. (USBR)
W70-03793

A MATHEMATICAL MODEL FOR PIT SLOPE STABILITY,
Arizona Univ., Tucson.
D. J. Hammel.
Quart Colo Sch Mines, Vol 64, No 3, p 53-69, July 1969. 17 p, 11 fig, 4 tab, 1 ref.

Descriptors: Rock mechanics, Engineering geology, *Rockslides, Slopes, Rock excavation, *Slope stability, Quarries, *Quarrying, Mathematical analysis, *Pits, Cut slopes, Regression analysis, Statistical analysis, Correlation analysis, Correlation techniques, Mathematical models.
Identifiers: *Rock slope stability, Variables, Open pit mining.

When a clope failure occurs in construction and mining industries, an engineer is usually called in to determine the cause of the slide. To prevent damages and loss of life from rock slides, rock slope movement must be analyzed prior to failure. A method is given for determining the variables that affect slope movement in an unstable slope and the effect of these variables on slope movement. A sample application of the method is given for an open-pit copper mine in Arizona. First, a case history was developed for an unstable pit slope and then a statistical model of slope movement was developed by multiple correlation and regression analysis. Correlation coefficients were evaluated to select the statistically significant independent variables. Regression analysis predicts slope movement from known values of the independent variables. The best equation for predicting slope movement contained terms for precipitation, mining rate at the toes of the slope, amount of water added to a leach dump near the slope, and water pumped from the pit. Predicted rates of slope movement agreed closely with actual measured values. The statistical model developed is applicable to this particular unstable slope. (USBR)
W70-03794

8F. Concrete

FIELD AND LABORATORY STUDIES OF THE SULPHATE RESISTANCE ON CONCRETE,
Portland Cement Association, Skokie, Ill
G. J. Verbeck
Portland Cement Ass Res Dep Bull 227, p 113-124, Apr 1967. 15 p, 9 fig, 3 tab, 4 ref

Descriptors: *Portland cements, Cements, *Concrete mixes, Field tests, Concretes, *Concrete technology, Concrete testing, Air entrainment, Soil environment, Exposure, Environmental tests, *Durability, Deterioration, Sea water.
Identifiers: *Sulfate-resisting cements, *Sulfate attack, Concrete deterioration, Cement chemistry, Cement content, Concrete properties.

Studies of the sulfate resistance of concrete, conducted by the Portland Cement Association, are part of a long-time study of cement performance in concrete and involve field exposure tests of concrete to sulfate soils and sea water. Field exposure in sulfate soils shows the importance of the tricalcium aluminate content of cement, and the cement content and air content of the concrete. Observed sulfate resistances are compared with the tricalcium aluminate content estimated by 4 different methods. Studies of concrete in warm sea water show that concrete made with cement having a calculated tricalcium aluminate content below 11.2% has performed without deterioration through 25 yr of exposure. High tricalcium aluminate contents may provide some benefit against corrosion of steel when concrete cover is minimal. (USBR)
W70-03796

8G. Materials

FIELD TESTS OF ALUMINUM ORTHOTROPIC BRIDGE DECK,
Aluminum Co. of America, New Kensington, Pa. Alcoa Research Labs.
Maurice L. Sharp.
Proc Amer Soc Civ Eng, J Struct Div, Vol 95, No ST11, p 2463-2476, Nov 1969. 14 p, 16 fig, 3 tab, 3 ref, append.

Descriptors: Aluminum, *Bridges, Deflection, *Field tests, Structural behavior, Loads (Forces), Plates, Static tests, Stress, Stress analysis, Structural members, Structural engineering, Testing, Test procedures.
Identifiers: *Orthotropic bridges, *Bridge decks, Dynamic response, Dynamic loads, Dynamic tests, Loading tests, Static behavior.

Field tests to determine stresses and deflections of an orthotropic aluminum bridge deck caused by a 20-ton truck load are presented. A typical deck panel having a 3/8-in.-thick polyester resin-silica sand wearing surface was instrumented with electrical resistance strain gages and dial gages. Stresses and deflections were determined for 18 different static positions of the truck on the panel. Test values were lower but generally in good agreement with those calculated by AISC design procedures. Dynamic stresses were evaluated for truck speeds up to 20 mph and were about the same as corresponding stresses caused by static load. No measurable vibration of the deck occurred during or after passage of the truck. Lack of significant dynamic effects possibly was caused by a relatively high natural frequency of the deck and damping characteristics of the polyester resin. Transverse stresses in the deck plate with the wearing surface were about 80% of values in a plate without the wearing surface. (USBR)
W70-03795

8I. Fisheries Engineering

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For primary bibliographic entry see Field 06E.
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SELECTED WATER RESOURCES ABSTRACTS

VOLUME 3, NUMBER 11
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SELECTED
WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
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VOLUME 3, NUMBER 11
JUNE 1, 1970

W70-04045 -- W70-04543

Use of funds for printing this publication approved by the Director of the Bureau of the Budget, September 4, 1968.

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

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AN EXPERIMENTAL STUDY OF THE STRUCTURE, THERMODYNAMICS AND KINETIC BEHAVIOR OF WATER,
Midwest Research Inst., Kansas City, Mo.
Frank T. Greene, Thomas A. Milne, A. E. Vandergrift, and Jacob Beachey.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC 20402 - Price $0.65. Office Saline Water Research and Development Progress Report No 493, Oct 1969. 60 p, 19 fig, 11 tab, 40 ref. OSW Contract No 14-01-0001-1479.

Descriptors: *Water properties, *Thermodynamic behavior, Analytical techniques, Spectrometers, Free energy, Temperature, Research and development.
Identifiers: *Water cluster formation.

Mass spectrometry and molecular beam sampling techniques were used to obtain information on the thermodynamics and rates of water cluster formations. High and low pressure measurements of cluster formation give apparent concentrations (and free energy of formation) for dimers and trimers as well as an upper limit for the concentration of tetramers. The mole fractions of trimers and tetramers in steam at 1 atmosphere and 373 deg K were calculated. The dimerization rate constant is strongly temperature-dependent and is much less at 300 deg K than three-body collisional frequency factors would indicate. Reverse reactions are quite important in dimer growth. Dimer is formed in appreciable quantities near the end of expansion, in the ill-defined transition region to collisionless flow. More research in this area is recommended. (Carstea-USGS)
W70-04085

PHYSICAL PROPERTIES OF SEA WATER SOLUTIONS: HEAT CAPACITY,
National Engineering Lab., East Kilbride (Scotland).
D. T. Jamieson, J. S. Tudhope, R. Morris, and G. Cartwright.
Desalination, Vol 7, No 1, p 23-30, Nov 1969. 8 p, 4 fig, 3 tab, 7 ref.

Descriptors: *Water properties, *Sea water, *Thermal properties, Thermodynamic behavior, Thermodynamics, Scaling, Desalination, Distillation, Aqueous solutions, Saline water.
Identifiers: Heat capacity (Sea water).

The heat capacity of sea water and its concentrates has been measured in the temperature range 80 deg to 180 deg C using a differential heating method. An equation is given which fits the measured values of heat capacity, together with those from the literature, to within their various experimental accuracies. (Knapp-USGS)
W70-04325

1B. Aqueous Solutions and Suspensions

A NEUTRON SCATTERING STUDY OF WATER AND IONIC SOLUTIONS,
Union Carbide Corp., Tuxedo, N.Y.
G. J. Safford, and P. S. Leung.
Available from Superintendent of Documents, U. S. Government Printing Office, Wash, D C - Price 55 cents per copy. Office of Saline Water Research and Development Progress Report No 485, September 1969. 36 p, 13 fig, 43 ref.

Descriptors: *Neutron absorption, *Aqueous solutions, Frequency analysis, Diffusion, Magnesium compounds, Sodium chloride, Cesium, Ions, Hydration, Kinetics, Analytical techniques.
Identifiers: *Neutron inelastic scattering, Intermolecular frequencies, Ion hydration.

Neutron inelastic scattering was used to study the dependences on concentration, cations, and anions of the intermolecular frequencies and the diffusive kinetics of water molecules in aqueous solutions. The intermolecular frequencies at lower concentrations of magnesium chloride, NaCl and CsCl were nearly identical with those of water. With increasing concentration, new frequencies characteristic of primary hydration complexes appeared and intensified. The frequencies and diffusive parameters of solutions containing small or highly charged cations were primarily determined by the cations and only secondarily affected by monovalent anions. In contrast, a strong dependence on anions in solutions of larger, single-charged cations was observed at intermolecular frequencies and in diffusive kinetics. (Carstea-USGS)
W70-04347

02. WATER CYCLE

2A. General

RUNOFF FROM FOREST AND AGRICULTURAL WATERSHEDS,
Colorado State Univ., Fort Collins. Natural Resources Center.
M. E. Holland.
Available from the Clearinghouse as PB-189 764, $3.00 in paper copy, $0.65 in microfiche. Colorado State Univ, Natural Resources Center, Partial Completion Report, June 30, 1969. 19 p, 4 tab, 3 fig, 3 ref. OWRR Project A-002-COLO.

Descriptors: *Surface runoff, *Runoff, *Unit hydrograph, *Rainfall-runoff relationships, Forest watersheds, Agricultural watershed.

The dichotomy between forest and agricultural watersheds with areas less than 40 square miles has been studied by looking at the time distribution of runoff from storm rainfall events. The direct investigation of rise times for hydrographs gave inconclusive results, but led to a more fruitful second approach. The second part of the investigation focused on the unit hydrograph as the characteristic response of the watershed. The unit hydrograph can be represented mathematically by two-parameter incomplete gamma function. The rise time for the unit hydrograph is a convenient and significant parameter in determining the shape of the unit hydrograph. The effects of the physiographic parameters of watersheds were removed by determining a hypothetical median watershed and varying the cover characteristics from forest to agricultural. The influences of steeper slopes that are common in forest watersheds were thus eliminated. The results clearly indicate the significant damping that forest cover causes in the watershed response to rainfall.
W70-04055

STOCHASTIC ANALYSIS OF HYDROLOGIC SYSTEMS,
Illinois Univ., Urbana. Dept. of Civil Engineering.
Ven Te Chow.
Available from the Clearinghouse as PB-189 791, $3.00 in paper copy, $0.65 in microfiche. Completion Report, Illinois Water Resources Center, Research Report No 26, Dec 1969. 34 p, 8 fig, 14 ref. OWRR Project A-029-ILL.

Descriptors: Systems analysis, Stochastic processes, Synthetic hydrology, Water resources develop, Streamflow, Evapotranspiration, Storage, Water yield, Hydrology.
Identifiers: Watershed studies, Precipitation, Hydrologic models.

Hydrologic phenomena are in reality stochastic in nature; that is, their behavior changes with the time in accordance with the law of probability as well as with the sequential relationship between the occurrences of the phenomenon. In order to analyze the hydrologic phenomenon, a mathematic model of the stochastic hydrologic system to simulate the phenomenon must be formulated. In this study, a watershed is treated as the stochastic hydrologic system whose components of precipitation, runoff, storage, and evapotranspiration are simulated as stochastic processes by time series models to be determined by correlograms and spectral analysis. The hydrologic system model is then formulated on the basis of the principle of conservation of mass and composed of the component stochastic processes. To demonstrate the practical application of the method of analysis so developed, the upper Sangamon River basin above Monticello in east central Illinois is used as the sample watershed. The watershed system model so formulated can be employed to generate stochastic streamflows for practical use in the analysis of water resources systems. This is of particular value in the economic planning of water supply and irrigation projects which is concerned with the long-range water yield of the watershed.
W70-04072

STUDY OF THE INTERRELATIONSHIP BETWEEN SURFACE AND UNDERGROUND WATERS IN THE AY RIVER BASIN (RUSSIAN),
Institut po Proektirovaniiu Predpriiatii Nikelevoi Promyshlennosti, Leningrad (USSR).
P. V. Molitvin.
In: Trudy Soveshchaniya po Voprosam Kompleksnogo Izucheniya Rezhima Poverkhnostnykh i Podzemnykh Vod v Karstovynkh Rayonakh (Proc of Conf on Complex Problems of Surface and Groundwater Systems in Karstic Regions), Upravleniye Gidrometeorologicheskoy Sluzhby, Ukr, SSR, p 114-121, 1969. 8 p, 1 fig, 2 tab, 4 ref.

Descriptors: *Surface-groundwater relationships, *Groundwater, *Groundwater movement, *River basins, *Karst, Mountains, Geology, Sinks, Runoff, Discharge (Water), Snowmelt, Rivers, Water loss, Mathematical studies, Mining engineering, Floods, Tracers, Dye releases.
Identifiers: *USSR, Ay River basin.

Hydrological and karstic characteristics of the central watershed of the Ay River and the intercommunication between the surface waters and underground waters were investigated by fluorescent techniques. In carrying out mining operations in the basin, the main water seepage is due to the surface waters of the Kamenka River basin. Atmospheric precipitation over the karstic area will also contribute to the possible flooding of tunnels and shafts. (Gabriel-USGS)
W70-04110

SOME CONSIDERATIONS IN THE ADAPTION OF MARKOV PROCESS THEORY TO RAINFALL-RUNOFF PHENOMENON,
Utah Water Research Lab., Logan.
Jay M. Bagley.
Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 79, p 633-640, 1967. 8 p, 1 fig, 2 tab, 1 ref.

Descriptors: *Rainfall-runoff relationships, *Streamflow forecasting, *Synthetic hydrology, *Markov processes, Time series analysis, Model studies, Mathematical models, Stochastic processes, Probability.
Identifiers: Watershed models.

The rainfall-runoff process may be characterized by a Markovian stochastic model. The system description utilizes finite time increments of one day for the volumes of precipitation, evapotranspiration, infiltration, soil moisture storage changes, and runoff. The validity of a stationarity assumption (time-independence) for soil moisture storage on a monthly basis was examined and found to be of questionable utility for obtaining runoff probabilities. Equivalent monthly probability distributions were developed which gave considerable improvement and offer promise in providing working tools for purposes of engineering design. The effect

of size of the finite water increment employed in the model is evaluated. Larger increments of water make approximations to the frequency distributions of daily rainfall much more crude. They also give poor approximations to the functions describing processes in the system that change more slowly with time. The study suggests modifications revealed and make the approach more useful. (Knapp-USGS)
W70-04254

A STATISTICAL METHOD TO SEARCH FOR A RAINFALL-RUNOFF RELATIONSHIP,
Universidad Nacional Autonoma de Mexico, Mexico City. Instituto de Ingenieria.
A. Capella Vizcaino, and J. L. Sanchez Bribiesca.
Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 77, p 616-623, 1967. 8 p, 5 fig, 6 ref.

Descriptors: *Rainfall-runoff relationships, *Streamflow forecasting, *Systems analysis, Model studies, Synthetic hydrology, Input-output analysis, Simulation analysis, Mathematical models, Floods.
Identifiers: Hydrologic systems analysis.

Classical methods too often fail to relate rainfall and runoff in basins, when applied to specific cases. The random characteristics of the phenomenon seem to be the main cause. A 'black box' approach, based on Automatic Control techniques is introduced in this paper, as a synthesis system obtained from observed inputs (rainfall) and outputs (runoff). The model can take into consideration rainfall distribution in a basin area, once a weighing function has been established for each input, from a set of orthogonal functions. Changes in the weighing functions are considered, although the great number of parameters involved, and the scarcity of data, introduce limitations to the selected model; besides, it is difficult to attach a reasonable physical interpretation to the results. (Knapp-USGS)
W70-04256

ANALYSIS OF 'BLACK BOX' RELATIONSHIP BETWEEN RAINFALL AND RUNOFF,
Pittsburgh Univ., Pa. Dept. of Civil Engineering.
Chao-Lin Chiu.
Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 76, p 608-615, 1967. 8 p, 6 ref. FWPCA Grant 5 T1-WP-41-04.

Descriptors: *Streamflow forecasting, *Rainfall-runoff relationships, *Systems analysis, *Input-output analysis, Simulation analysis, Model studies, Mathematical models, Hydrologic budget, Unit hydrographs, Synthetic hydrology.
Identifiers: Hydrologic systems analysis.

General methods and procedures for determining the rainfall-runoff relationships by the 'black box' analysis are presented. The mathematical technique involves the use of functionals and statistics. Problems concerning the non-linearity and nonstationarity of hydrologic systems are discussed, and possible approaches are presented for solving such problems. (Knapp-USGS)
W70-04257

TRANSFORMATION OF DETERMINISTIC AND STOCHASTIC PROCESSES IN HYDROLOGY,
Arizona Univ., Tucson.
Chester C. Kisiel.
Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 75, p 600-607, 1967. 8 p, 23 ref.

Descriptors: *Stochastic processes, *Parametric hydrology, Linear programming, Input-output analysis, Model studies, Statistical models, Synthetic hydrology, Forecasting, Streamflow forecasting, Statistical methods, Time series analysis.
Identifiers: *Stochastic hydrology.

The theory of random functions forms the mathematical foundation of parametric and stochastic hydrology and shows their inherent unity. The stochastic approach is the more general. The theory of random functions is employed to predict the output statistics of a variety of transformation processes of interest in hydrology: rainfall to runoff or reservoir inflow to reservoir outflow. In general, such prediction is possible only for linear systems with or without memory. It is recognized that hydrologic transformations are nonlinear; yet, it is suggested that linear systems theory provides a first-order approximation to changes in output statistics for planned or unplanned modifications of the hydrologic environment. The changes in input-output statistics may be used as a measure of linearity of basin response. These nonstationarities as introduced by human manipulation of watershed response are important to the prediction problem, and thus to the economic design of hydraulic structures subjected to hydrologic events whose average return periods change as a result of man's intervention. (Knapp-USGS)
W70-04258

A CASE FOR THE SIMULTANEOUS APPLICATION OF DETERMINISTIC AND STOCHASTIC METHODS IN HYDROLOGY,
Manchester Coll. of Science and Technology (England).
For primary bibliographic entry see Field 04A.
W70-04259

EFFECT OF WATERSHED COVER ON OVERLAND FLOW FROM A MAJOR STORM IN SOUTHWESTERN WISCONSIN,
Forest Service (USDA), La Crosse, Wis.
For primary bibliographic entry see Field 02E.
W70-04316

APPLICATION OF A COMPUTER MODEL TO A DESERT WATERSHED,
Arizona Univ., Tucson. Dept. of Watershed Management.
J. H. Kitchen, and J. L. Thames.
Progressive Agriculture in Arizona, Vol 21, No 6, p 12-13, November-December 1969. 1 fig.

Descriptors: *Arizona, *Watershed management, *Computer models, *Runoff, *Small watersheds, Hydrologic cycle, Model studies, Hydrographs, Deserts.
Identifiers: *Purdue University Watershed Model, Tucson Basin, Arizona.

Approximately five percent of the total precipitation which falls on Arizona deserts is retained for man's use. More efficient watershed management would be possible if runoff could be accurately predicted. The most promising new method is watershed modeling using computers. Although the Purdue University model was designed for use on cultivated land in Indiana, it was chosen for study of a small desert watershed in the Tucson Basin of Arizona. The model was applied without modification and the result was a close agreement in general shape and size between the predicted and actual hydrograph. The differences that did occur may be the result of the uneven rainfall, as the model assumes uniform rainfall distribution. The study indicates that practical working watershed models can be developed. (Carr-Arizona)
W70-04397

HYDROGEOLOGY OF THE RIO GRANDE VALLEY AND ADJACENT INTERMONTANE AREAS OF SOUTHERN NEW MEXICO,
New Mexico State Univ., University Park. Water Resources Research Inst.
W. E. King, J. W. Hawley, A. M. Taylor, and R. P. Wilson.
New Mexico State University, Las Cruces, Water Resources Research Institute, Report No 6, June 1969. 141 p, 6 fig, 4 tab, 79 ref, map.

Descriptors: *Hydrogeology, *Aquifers, *New Mexico, *Groundwater, *Geomorphology, Geology, Rio Grande, Groundwater barriers, Groundwater basins, Semiarid climates, Soils, Geologic formations, Stratigraphy, Wells, Water chemistry
Identifiers: *Rio Grande Valley

The region under investigation is a 3600 square-mile area of southern New Mexico lying along the Rio Grande Valley. The local mountains are mainly of the block-faulted type. Consolidated rocks are a primary barrier to the movement of groundwater and these rocks serve as an important source of the dissolved solids found in local water supplies. There are four major hydrogeologic units of these rocks: Precambrian and Tertiary igneous intrusive and metamorphic rocks; Paleozoic, late Mesozoic, and early Tertiary carbonate and other clastic sedimentary rocks; Tertiary volcanic and associated sedimentary rocks; and late Cenozoic basalts. The two major groundwater reservoirs in the region are the late Quaternary Rio Grande Valley fill (80 feet thick) and the Miocene to mid-Pleistocene Santa Fe Group basin fill (3500 feet thick). The Valley fill is capable of high-yield aquifers and is an important water resource for New Mexico. The upland basin fill has less permeable aquifer beds and therefore its wells do not produce as much water. (Carr-Arizona)
W70-04399

THE CLIMATES OF BAJA CALIFORNIA (IN SPANISH),
Universidad Nacional Autonoma de Mexico, Mexico City. Instituto de Geografia; and Universidad Nacional Autonoma de Mexico, Mexico City. Instituto de Geografia.
For primary bibliographic entry see Field 02B.
W70-04409

2B. Precipitation

A SUMMARY OF SEASONAL TEMPERATURE AND PRECIPITATION DATA FOR THE INTERIOR FORESTED AREA OF ALASKA,
Forest Service (USDA), Juneau, Alaska. Pacific Northwest Forest and Range Experiment Station.
Robert W. Funsch.
USDA Forest Serv Res Note NOR-9, 1964. 50 p, 1 fig, 45 tab.

Descriptors: *Climatic data, *Subarctic, Air temperature, Alaska, *Precipitation (Atmospheric), Meteorology, Seasonal.
Identifiers: Boreal forests, Growing season, Degree days.

Mean extreme air temperatures, growing degree days, dry days (<0.01-in ppt.) and precipitation were summarized by 5-day intervals for 22 stations in central Alaska for April 1 through October 31 for the period 1946 through 1961 as an aid for interpreting forest research results. The range of one standard deviation was computed for growing degree days, dry days, and precipitation. (Helmers-Forest Service)
W70-04066

ISOTOPIC COMPOSITION AND ORIGIN OF THE ATMOSPHERIC WATER VAPOR IN THE REGION OF LAKE LEMAN (IN FRENCH),
Pisa Univ. (Italy). Lab. of Nuclear Geology.
For primary bibliographic entry see Field 02K.
W70-04304

EFFECTS OF WEATHER MODIFICATION ON PLANT AND ANIMAL COMMUNITIES,
Michigan Univ., Ann Arbor. School of Natural Resources.
Charles F. Cooper.
American Association for the Advancement of Science, Committee on Arid Lands, Symposium on Weather Modification, New York, December 30, 1967. Miss 11 p, 9 ref.

Descriptors: *Weather modification, *Artificial precipitation, Cloud seeding, *Biological communities, Ecology, *Ecosystems, *Arid lands, Semiarid climates, Social aspects, Rainfall.
Identifiers: *Ecological effects.

A TEMPORARY CHANGE IN PRECIPITATION MAY ALTER RATES AND PATHWAYS THROUGH WHICH ENERGY IS CHANNELLED, BUT THE STRUCTURE OF THE SYSTEM IS ONLY SLIGHTLY MODIFIED. However, with a long term increase in rainfall, altered patterns of reproduction and growth may cause the emergence of an entirely new community structure. Given certain assumptions as to the nature of the weather changes, one may hypothesize the following ecological effects in arid regions: (1) species will respond as individuals, not as communities; (2) biological changes from a given percentage increase in rainfall will be greatest in semiarid climates and somewhat less in arid regions, (3) areas of uniform precipitation will be the most susceptible to the planned weather changes; (4) communities with stable populations will be the most sensitive to climatic change; (5) disappearance of a species from an area will be more the result of competition from favored species already present than of competition from invaders; and (6) moderately grazed livestock range is likely to change more in species composition than either heavily grazed or ungrazed areas. These hypotheses, based almost entirely on inference, await testing and refining with empirical data. Ecology is at the threshold of useful predictions which could be employed in the political decision framework. (Carr-Arizona)
W70-04391

THE CLIMATES OF BAJA CALIFORNIA (IN SPANISH),
Universidad Nacional Autonoma de Mexico, Mexico City. Instituto de Geografia; and Universidad Nacional Autonoma de Mexico, Mexico City. Instituto de Geografia.
Enriqueta Garcia, and Pedro A. Mosino.
Comite Nacional Mexicano para el Decenio Hidrologico Internacional, Memoria 1966-1967, 1968. p 29-56 21 fig, 1 tab, 13 refs, 1 append., 1 map.

Descriptors: *Climatic zones, *Arid lands, *Mexico, *Precipitation (Atmospheric), Air circulation, Temperature, Rainfall disposition, Variability, Winter, Summer.
Identifiers: *Baja California.

The peninsula of Baja California contains stretches of extremely arid land owing to climatic fluctuations. The extreme northwest region receives most of its precipitation during winter from a Mediterranean type of regime. The extreme southeast portion has a summer rainfall regime. The intermediate area receives rain from either or both regimes. These variations in climate, rainfall, temperature and air movements are discussed in depth and are accompanied by detailed charts and maps. (Moore-Arizona)
W70-04409

COLD AIR DRAINAGE ON A FORESTED MOUNTAIN SLOPE,
Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
For primary bibliographic entry see Field 02D.
W70-04444

2C. Snow, Ice, and Frost

SNOW ACCUMULATION IN RELATION TO FOREST CANOPY,
Colorado State Univ., Fort Collins. Natural Resources Center.
J. Meiman, H. Frochlick, and R. E. Dils.
Available from the Clearinghouse as PB-189 782, $3.00 in paper copy, $0.65 in microfiche. Colorado State Univ, Natural Resources Center, Partial Completion Report, June 30, 1969. 8 p, 1 tab, 3 fig, 2 ref. OWRR Project A-002-COLO.

Descriptors: *Snow management, *Snow pack, Snow, Snowfall.

Maximum snowpack water equivalent is measured at 123 points in the spring of 1966, 1967, and 1968. These points are distributed over three transects within a 4 square mile area in the Colorado Front Range. The north-facing slope ranges in elevation from 2900 to 3300 meters covered by Picea engelmanni and Abies lasiocarpa at the upper elevations and Pinus contorta at the lower. Water equivalent increases an average of 42mm/100m although only 28% of the total variance in water equivalent is associated with elevation. Forest cover measured by a Lemmon spherical densiometer within a cone of 114 deg is significant in only one of the three years. Neither corwn cover by compass quadrants, crown cover within a cone of 21 deg, not timber stand size classifications improve on the 114 deg cone canopy measurement in explaining snow accumulation variability. Individual points vary widely in their relative accumulation from year to year; the coefficient of determination for 1966 versus 1968 water equivalent is only 25%. Snow water equivalent versus snow depth gives r values of 0.86, 0.90, and 0.73 for the three years respectively.
W70-04056

CONTROLLED ACCUMULATION OF BLOWING SNOW,
Colorado State Univ., Fort Collins. Natural Resources Center.
J. L. Rasmussen.
Available from the Clearinghouse as PB-189 783, $3.00 in paper copy, $0.65 in microfiche. Colorado State Univ, Natural Resources Center, Completion Report, June 13, 1969. 15 p, 8 ref. OWRR Project A-004-COLO.

Descriptors: *Snow management, Snowpack, *Snow fences, Water yield improvement.

An experiment designed to trap falling snow and control drifting snow over the high alpine regions of the Colorado Rocky Mountains is described. The experiment is based on the fact that a wind shift occurs following many snow occurrences over this region and a snow fence system was developed to act both as a trap for falling snow and as a channelling mechanism to control drifting snow. The report describes various fence designs that were tested and provides photographic evidence of the fence systsm's influence on the blowing snow. The system was effective in creasing the volume of snow in the target region but the density of snow in the controlled drift was found to be only eighty percent of the density in adjacent natural drift.
W70-04057

THE INFLUENCE OF FREEZING AND THAWING ON SOIL MOISTURE,
Department of Agriculture, Swift Current (Saskatchewan). Research Station.
W. L. Pelton, C. A. Campbell, and W. Nicholaichuk.
Proceedings of Hydrology Symposium No 6 on Soil Moisture, Saskatchewan Univ, Nov 15-16, 1967, p 241-267, 1968. 27 p, 12 fig, 33 ref.

Descriptors: *Soil water movement, *Frozen soils, *Freezing, *Thawing, Soil moisture, Grasslands, Rainfall, Infiltration, Snowmelt, Snow, Runoff, Soil erosion, Moisture content, Permeability, Frost heaving.
Identifiers: *Canada, *Saskatchewan, Swift Current.

The influence of freezing and thawing on soil moisture is discussed in relation to the prairie region of Canada, where the rainfall is limited. Winter moisture can be conserved by trapping the snow on the soil surface and by infiltration of snowmelt into the soil. However, infiltration rates of frozen soil vary widely and depend upon the soil moisture content at the time of freezing. Soils which are dry during the fall are less susceptible to runoff and erosion in the spring than those which were frozen with high moisture content. Thermally induced moisture translocation is also a factor contributing to the reduction of infiltration rates. A literature review summarizes research findings related to permeability of frozen soils, moisture relocation, frost heaving and rate and depth of freezing and thawing. Field and laboratory studies of soil temperatures and moisture contents at Swift Current, Saskatchewan are presented. (Carstea-USGS)
W70-04112

THE ROLE OF STRESS CONCENTRATION IN SLAB AVALANCHE RELEASE,
Forest Service (USDA), Fort Collins. Rocky Mountain Forest and Range Experiment Station.
R. A. Sommerfeld.
Journal of Glaciology, Vol 8, No 54, p 451-462, 1969.

Descriptors: *Snow, *Avalanches, Mechanical properties, Snow management, Snowpacks, Colorado.
Identifiers: *Brittle fracture, Slab avalanches.

Slab avalanches are shown to be released by brittle fracture. An analogy is drawn in which the snowpack is considered to be a macroscopic, molecular model of glass. The analogy is examined qualitatively from two viewpoints: the Griffith fracture criterion, and stress concentration theory. The details of fracture propagation in a layered snowpack are explained by means of stress concentration theory, and many details of slab avalanches are shown to be consistent with the proposed mechanism. The significance of various fracture surface markings is pointed out.
W70-04198

0-18/0-16 RATIOS IN SNOW AND ICE OF THE HUBBARD AND KASKAWULSH GLACIERS,
Alberta Univ., Edmonton. Dept. of Geology; and Alberta Univ., Edmonton. Dept. of Physics.
For primary bibliographic entry see Field 02K.
W70-04260

2D. Evaporation and Transpiration

AN EXPERIMENTAL STUDY OF THE UPTAKE OF WATER BY SOYBEAN ROOTS,
Illinois Univ., Urbana. Dept. of Agronomy.
Arnold Klute.
Available from the Clearinghouse as PB-189 788, $3.00 in paper copy, $0.65 in microfiche. Completion Report, Illinois Water Resources Center, Research Report No 29, Jan 1970. 32 p, 5 tab, 12 fig, 7 ref. OWRR Project A-023-ILL.

Descriptors: *Evapotranspiration, Evaporation, Transpiration, *Soil water movement, Unsaturated flow, Soil moisture, *Soil-water-plant relationships.
Identifiers: *Water uptake, Source function, *Root density.

The water extraction from soil by plant roots was treated by assuming that such extraction could be represented as a continuously distributed sink (negative source) function. Preliminary results with soybeans grown in soil columns showed that a small part of the root system could extract most of the water used in transpiration. Root density as measured by root length per unit volume of soil was not directly correlated with water uptake. Both the hydraulic conductivity of the soil and root density played a major role in determining the rate of extraction of water at a given depth in the soil. Water uptake per unit root length ranged up to about 0.5 cm3/cm of root/day. This kind of data gives more insight into the conditions at the root-soil interface. The experimental work in this project was developed from a numerical analysis which was supported by an earlier OWRR project (Project No. 65-03G), and is an example of a basic ap-

proach to the study of the interaction of the plant with its environment in which the available degree of understanding of the water flow process in soil is brought to bear upon the plant-soil interaction. The importance of evapotranspiration is well known in the hydrologic cycle. The experimental work described in this report makes a further contribution toward our understanding of this process.
W70-04069

SODIUM HAZARD OF BICARBONATE IRRIGATION WATERS,
California Univ., Riverside. Dept. of Soils and Plant Nutrition.
For primary bibliographic entry see Field 02K.
W70-04104

NEW DESIGN OF A LOW-COST HYDRAULIC LYSIMETER SYSTEM FOR FIELD MEASUREMENT OF EVAPOTRANSPIRATION,
Hebrew Univ., Jerusalem (Israel). Dept. of Soil Science; and National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research.
D. Hillel, S. Gairon, V. Falkenflug, and E. Rawitz.
Israel Journal of Agricultural Research, Vol 19, No 2, p 57-63, April 1969. 3 fig, 1 plate, 6 ref.

Descriptors: *Lysimeters, *Equipment, *Evapotranspiration, *Instrumentation, Water balance, Arid lands, Costs, On-site data collections.
Identifiers: *Israel, Negev Desert.

A low-cost hydraulic-pressure lysimeter system was constructed which gives reproducible data of relatively high accuracy. It can continuously weigh 8 cubic meters of soil for evapotranspiration and water-balance studies. It should be possible to construct such a centrally-monitored four-lysimeter complex for about $4000. Maintenance costs are low due to the absence of moving parts. This system has been in operation for the past three years in the Negev Desert at Gilat, Israel. (Carr-Arizona)
W70-04401

TRANSPIRATION, EVAPORATION AND DEEP DRAINAGE LOSSES FROM AN ORANGE PLANTATION,
National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research.
For primary bibliographic entry see Field 03F.
W70-04402

COLD AIR DRAINAGE ON A FORESTED MOUNTAIN SLOPE,
Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
James D. Bergen.
J. Applied Meteor Vol 8, No 6, Dec 1969, p 884-895.

Descriptors: *Air circulation, Fluid mechanics, *Winds, Thermal radiation, Mountain climate, Climatology, Colorado.
Identifiers: *Katabatic flow, Mesoclimate.

The nocturnal cold airflow on a small forested slope was studied in an attempt to relate the volume and velocity of flow to the net radiation balance of the slope. The hillside, with an approximately 30% grade, was about 400 m long and covered with an uneven-aged spruce-fir stand of about 20 m height. The location was near Fraser, Colo., at an altitude of 3000 m. The vertical profiles of windspeed and air temperature were measured at various points on a transect approximating a streamline segment down the hill for several nights. Net radiation was measured at the base of the transect. Canopy closure and tree heights and diameters were measured on sample plots along the transect. The vertical profiles of potential temperature deficit and windspeed at the various station show approximate similarity when scaled by the height of the lowest inversion and by the average velocities and potential temperature deficits below that inversion. The latter varies in a nearly linear manner down the slope, and the inversion heights appear to be relatively constant over the range of net radiation rates observed. Assuming a corresponding analytical similarity for the equations of motion and the sensible heat balance, the last two phenomena are found to imply that U sub m varies as the one-half power of capital delta capital theta, capital delta capital theta varies as the two-thirds power of R sub o, and U sub m divided by the one-half power of gamma varies as chi where U sub m is the average velocity indicated above, capital delta capital theta the potential temperature drop down the slope, gamma the sine of the angle of the slope to the horizontal along the streamline, chi the downslope distance from the virtual origin of the flow measured along the streamline and R sub o the average net radiation loss on the slope. The data appear to confirm these results. The constants of proportionality calculated from the topographic contours, the estimated foliage distribution, and the scaled profiles of windspeed and potential temperature deficit are in fair agreement with observations.
W70-04444

2E. Streamflow and Runoff

STATISTICAL SUMMARIES OF ILLINOIS STREAMFLOW DATA,
Geological Survey, Champaign, Ill.
George W. Curtis.
Geological Survey Open-file report, 1969. 300 p, 1 fig, 1 append, index.

Descriptors: *Data collections, *Streamflow, *Hydrologic data, *Illinois, Statistics, Low flow, Hydrographs, Duration curves, Surveys.
Identifiers: Streamflow summary data, High flow.

Cooperative agreements between the U.S. Geological Survey and organizations of the State of Illinois for the systematic collection of streamflow records began in 1908. The data have been published in the form of daily discharges, and monthly and yearly summaries. A list of the publications (Water-Supply Papers) in which the records are published is given in the appendix. Three computer summaries of streamflow data given are of flow-duration, low-flow, and high-flow. This basic data release includes summaries for all gaging stations having five or more years of record as of September 30, 1966. The summary tables contain statistical information for 190 stations. (Knapp-USGS)
W70-04091

FLOOD PLAIN INFORMATION, ARKANSAS RIVER AND TRIBUTARIES, PULASKI COUNTY, ARKANSAS, PART 1.
Corps of Engineers, Little Rock, Ark.
For primary bibliographic entry see Field 04A.
W70-04094

FLOOD PLAIN INFORMATION - COASTAL FLOODING OF VIRGINIA BEACH, VIRGINIA.
Corps of Engineers, Norfolk, Va.
For primary bibliographic entry see Field 04A.
W70-04095

WATER RESOURCES AND DEVELOPMENT IN MASON VALLEY, LYON AND MINERAL COUNTIES, NEVADA, 1948-65,
Geological Survey, Carson City, Nev.
For primary bibliographic entry see Field 02F.
W70-04098

FLOOD PLAIN INFORMATION, SALADO CREEK, SAN ANTONIO, TEXAS.
Corps of Engineers, Fort Worth, Tex.
For primary bibliographic entry see Field 04A.
W70-04100

SOME CHARACTERISTICS OF RIVER AND SPRING RUNOFFS IN THE KARSTIC AREAS OF ESTONIA (RUSSIAN),
T. F. Eypre.
In: Trudy Soveshchaniya po Voprosam Kompleksnogo Izucheniya Rezhima Poverkhnostnykh i Podzemnykh Vod v Karstovykh Rayonakh (Proc of Conf on Complex Problems of Surface and Groundwater Systems in Karstic Regions), Upravleniye Gidrometeorologicheskoy Sluzhby, Ukr, SSR, p 96-106, 1969. 10 p, 2 fig, 5 tab, 7 ref

Descriptors: *Runoff, *River flow, *Springs, *Karst, Mapping, Gaging stations, Watersheds (Basins), Frequency, Discharge (Water), Water resources, Seasonal, Dry seasons, Water resources development.
Identifiers: *USSR, Estonia.

Hydrological characteristics of the rivers and springs of the karstic highlands of Estonia were investigated. Areas characterized by large mean annual discharges and the presence of some internal regularity were identified. It is recommended that the future water supply for the city of Tallin, Estonia, should be drawn from the total discharge of the rivers and springs characterized by positive karstic feeding. (Gabriel-USGS)
W70-04109

POTOMAC-SHENANDOAH RIVER BASIN.
Virginia Dept. of Conservation and Economic Development, Richmond. Div. of Water Resources.
For primary bibliographic entry see Field 06B.
W70-04111

MAGNITUDE AND FREQUENCY OF MISSOURI FLOODS,
Geological Survey, Rolla, Mo. Water Resources Div.
E. H. Sandhaus, and John Skelton.
Water Resources Report 23, Missouri Geological Survey and Water Resources, Dec 1968. 276 p, 7 fig, 1 plate, 2 tab, 14 ref, 2 append.

Descriptors: *Floods, *Missouri, *Data collections, *Statistics, Statistical methods, Frequency analysis, Flood forecasting, Stage-discharge relations, Streamflow, Climates, Topography, Regression analysis.
Identifiers: Flood data, Flood frequencies.

A statistical analysis was made of available flood-flow information from streams in the State of Missouri. Equations are presented for estimating the magnitude of future floods with recurrence intervals of 1.2, 2.33, 5, 10, 25, and 50 years at ungaged sites on most Missouri streams. Only two basin characteristics, drainage area and the average slope of the stream, are required to solve the equations. Appendices contain information on peak stages and discharges at gaging stations and miscellaneous sites, and flood-frequency data for gaging stations. (Knapp-USGS)
W70-04114

SIMULATION OF DAILY STREAMFLOW,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
Leo R. Beard.
Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State University, Fort Collins, Vol 1, Paper 78, p 624-632, 1967. 9 p, 5 tab, 4 ref.

Descriptors: *Synthetic hydrology, *Statistical models, *Stochastic processes, *Streamflow forecasting, Markov processes, Statistical methods, Correlation analysis, Regression analysis, Simulation analysis.
Identifiers: Daily streamflow model, Watershed models.

The stochastic process of daily streamflow generation is represented by a mathematical model including more than one element of serial correlation

and a random component in the generation of a daily streamflow. Differences in statistical and correlation characteristics between high flows and low flows are evaluated and tested. A generalized equation for generating daily streamflow at a single location is suggested. (Knapp-USGS)
W70-04130

MECHANICS OF FLOW IN OPEN CHANNEL SYSTEMS,
California Univ., Davis. Dept. of Water Science and Engineering.
For primary bibliographic entry see Field 08B.
W70-04296

CHANNEL CAPACITY AND FLOOD CHARACTERISTICS FOR SELECTED REACHES OF ELK CREEK AND TRIBUTARIES, DOUGLAS COUNTY, OREGON,
Geological Survey, Portland, Oreg.
Eugene A. Oster, and C. H. Swift, III.
Geological Survey Open-file Report, Oct 1969. 284 p, 256 fig, 1 plate, 3 tab, 2 ref.

Descriptors: *Floods, *Oregon, *Stage-discharge relations, *Data collections, Profiles, Hydrologic data, Hydrographs, Hydrograph analysis, Streamflow, Depth-area-duration analysis, Duration curves.
Identifiers: *Flood data, Douglas County (Oregon).

A study was made of the channel capacity and flood characteristics for selected reaches of Elk Creek and two of its tributaries, Pass and Yoncalla Creeks, Oregon. Water-surface profiles and the area inundated by floods with 2-year and 10-year recurrence intervals, and by the maximum flood of record, which occurred February 10, 1961, were made. The step-backwater method was used to define the flood profiles needed for delineating the areas inundated. Cross sections, high-water profiles, and other data used to develop the flood profiles are presented. (Knapp-USGS)
W70-04311

BASIC HYDROGEOLOGIC DATA, PINE RIDGE INDIAN RESERVATION, SOUTH DAKOTA,
Geological Survey, Vermillion, S. Dak.
For primary bibliographic entry see Field 02F.
W70-04314

EFFECT OF WATERSHED COVER ON OVERLAND FLOW FROM A MAJOR STORM IN SOUTHWESTERN WISCONSIN,
Forest Service (USDA), La Crosse, Wis.
Richard S. Sartz.
Forest Service Research Note NC-82, 1969. 4 p, 2 fig, 4 ref.

Descriptors: *Rainfall-runoff relationships, *Vegetation effects, *Wisconsin, Runoff forecasting, Streamflow forecasting, Alfalfa, Forests, Peak discharge, Hydrographs, Hydrograph analysis, Rainfall intensity.
Identifiers: Driftless Area (Wis).

A runoff study in the Driftless Area of Wisconsin showed that both total flow and peak rate of flow from a 3-hour, 4-inch rain were strongly affected by the watershed cover. Peak flows ranged from 2.42 inches per hour for alfalfa meadow to .010 inch per hour for undisturbed forest. The timing of flow on open-land and forested watersheds was similar. (Knapp-USGS)
W70-04316

THE INTERACTION OF INTERNAL WAVES WITH AN UNSTEADY NON-UNIFORM CURRENT,
Johns Hopkins Univ., Baltimore, Md. Dept. of Mechanics.
Yee-Chang Wang.
Journal Fluid Mechanics, Vol 37, Part 4, p 761-771, July 28, 1969. 11 p, 7 ref, 3 append.

Descriptors: *Waves (Water), *Ocean currents, *Non-uniform flow, *Unsteady flow, Hydraulics, Mathematical studies, Stratification, Thermocline, Ocean circulation, Thermal stratification.
Identifiers: Incompressible flow.

On the assumptions of incompressibility, negligible thermal conduction, salinity diffusion and viscosity, simple expressions are derived for the conservation equations of mass, momentum and energy when internal waves encounter an unsteady non-uniform current. These expressions of conservation equations are valid for all kinds of internal waves without regard to their different characteristics. From the dynamical conservation equations, we find that a stress-like term, the 'excess momentum flux tensor,' plays an important role in the interaction between internal waves and an unsteady non-uniform current. Furthermore, it is deduced from the energy balance equation that, in the encounter of interfacial waves with a steady non-uniform current in a two-liquid system, the waves are amplified in an adverse current but suppressed in an advancing current as a result of interaction of the waves with the current. This conclusion may explain the large amplitudes sometimes observed in internal waves near the confluence of currents and near fronts at the thermocline, the region in the ocean where the density gradient is a maximum. (Knapp-USGS)
W70-04326

SURFACE WATER RESOURCES OF SOUTH AFRICA,
University of the Witwatersrand, Johannesburg (South Africa). Dept. of Civil Engineering.
D. C. Midgley, and W. V. Pitman.
Witwatersrand University Hydrological Research Unit Report No 2/69, Aug 1969. 127 p, 29 fig, 23 tab, 22 ref, 7 append.

Descriptors: *Water resources, *Water resources development, *Surface waters, Streamflow, Rainfall-runoff relationships, Water storage, Hydrologic data, Data collections, Hydrogeology, Duration curves, Depth-area-duration analysis, Hydrographs, Frequency analysis, Flow characteristics, Low flow, Evaporation, Sedimentation, Silting, Mass curves.
Identifiers: *South Africa.

All comparatively long and reliable South African streamflow records that are reasonably unaffected by changing upstream land use were analyzed. Drought-flow sequences were abstracted and subjected to extreme-value analysis to yield critical mass curves as functions of return period. Discrete values are tabulated and referred to a regional drought-characteristic map. Storage analyses of the critical mass curves yield generalized co-axial diagrams relating gross draft, recurrence interval, month of year, and storage requirement. A generalized diagram is provided for each drought-characteristic region. Rainfall-runoff relationships were found to be influenced more strongly by vegetal cover than by any other catchment characteristic. The main drainage systems of the Republic were subdivided into secondary, tertiary and quaternary subcatchments. From regional rainfall-runoff relationships and isohyetal maps, mean river flow was computed for each quaternary subcatchment. (Knapp-USGS)
W70-04334

RESPONSE OF GAS-PURGED MANOMETERS TO WATER-LEVEL SURGES,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 07B.
W70-04337

FLOOD OF AUGUST 1969, RICHMOND QUADRANGLE, RICHMOND, VIRGINIA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-04348

FLOOD OF AUGUST 1969 ON MAURY RIVER AT BUENA VISTA, VIRGINIA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-04349

FLOOD OF AUGUST 1969, DREWRYS BLUFF QUADRANGLE, RICHMOND, VIRGINIA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-04350

RESERVOIR FLOOD ROUTING ANALYSIS,
Sheffield Univ. (England).
E. J. Sarginson.
Civ Eng Pub Works Rev, Vol 64, No 752, p 275-277, Mar, 1969. 2 p, 3 fig, 2 tab, 4 ref.

Descriptors: Flood control, Reservoirs, *Flood routing, Flood peaks, *Flood hydrographs, Mathematical analysis, Reservoir storage, Floods, *Reservoir operation, Discharges, Flow rates, Regulation, Foreign design practices.
Identifiers: *Flood hydrology, Flood stages, *Reservoir management, Accuracy, Great Britain.

Using an arithmetical integration is the usual procedure for routing a flood of variable intensity through a reservoir. The procedure is tedious when a large number of short steps must be considered for accuracy. A more rapid analytical solution is desirable. Floods of constant intensity are solved easily in terms of Gould's function, and Mathieson has extended the method to include reservoirs in which the surface area increases with rising water level. For a flood of variable intensity, an analytical solution is not managed easily. A method is presented for calculating a rising flood using the weir formula in the usual form. Gould's function is recommended for the constant part of the flood hydrograph. A further method is developed for the falling flood. An example of the proposed routing analysis method gives a solution identical to results of the more lengthy arithmetical procedure. (USBR)
W70-04543

2F. Groundwater

SOLUTION GEOCHEMISTRY OF THE WATER OF LIMESTONE TERRAINS,
Kentucky Water Resources Inst., Lexington.
For primary bibliographic entry see Field 02K.
W70-04061

GROUNDWATER RESOURCES OF GREGG AND UPSHUR COUNTIES, TEXAS,
Geological Survey, Austin, Tex.
Matthew E. Broom.
Report published and distributed by Texas Water Development Board, PO Box 12386, Austin Tex 78711. Texas Water Development Board Report 101, Oct 1969. 76 p, 16 fig, 9 tab, 41 ref.

Descriptors: *Water resources, *Groundwater, *Aquifers, *Texas, Water wells, Water yield, Transmissivity, Water quality, Data collections, Hydrologic data, Hydrogeology, Water levels.
Identifiers: Gregg County (Tex), Upshur County (Tex).

Gregg and Upshur Counties, in northeast Texas, are underlain by two aquifers that are capable of sustaining additional development. The aquifers consist of the Wilcox Group and Carrizo Sand (Carrizo-Wilcox aquifer) and the Queen City Sand. Of the total pumpage of 3.02 mgd in 1966, 2.84 mgd was from the Carrizo-Wilcox aquifer. At the 1966 hydraulic gradient (8 feet per mile), about 12,000 acre-ft per year (10.9 mgd) was being transmitted through this aquifer. The amount that is perennially available is not known, but it is probably at least two times that pumped in 1966. The water in the Carrizo-Wilcox generally is soft,

but with high chloride content. The Queen City Sand, which crops out over nearly 90% of the area, is relatively undeveloped. In 1966, only 200 acre-ft (0.18 mgd) was pumped from the aquifer. The transmissibility of the aquifer is about 5,000 gpd per foot as compared to 20,000 gpd per foot for the Carrizo-Wilcox. The water in the Queen City Sand is uniformly low in mineralization except for iron. (Knapp-USGS)
W70-04092

GROUNDWATER RESOURCES OF KERR COUNTY, TEXAS,
Geological Survey, Austin, Tex.
Richard D. Reeves.
Report published and distributed by Texas Water Development Board, PO Box 12386, Austin, Texas 78711. Texas Water Development Board Report 102, Nov 1969. 58 p, 12 fig, 7 tab, 30 ref.

Descriptors: *Water resources, *Groundwater, *Aquifers, *Texas, Water wells, Water yield, Transmissivity, Water quality, Data collections, Hydrologic data, Hydrogeology, Water levels.
Identifiers: Kerr County (Tex).

The principal water-bearing units in Kerr County, Texas, are the Hosston and Sligo Formations, the Hensell Member of the Pearsall Formation, and the Edwards and associated limestones. The Glen Rose Limestone is of lesser importance. A total of about 3,600 acre-feet or 3.2 mgd of groundwater was pumped from wells in 1966. Additional groundwater is available for development. An average of about 52,000 acre-feet per year is discharged from the Edwards and associated limestones through springs and seeps. An additional 6,000 acre-feet is discharged from the upper member of the Glen Rose Limestone. However, a substantial increase in withdrawals from the Edwards and associated limestones would necessarily result in a reduction in the natural groundwater discharge, which in turn would result in a reduction in the base flow of the Guadalupe River. The chemical quality of the groundwater in the aquifers is generally suitable for public supply and industrial use, and is excellent for irrigation. (Knapp-USGS)
W70-04093

WATER RESOURCES AND DEVELOPMENT IN MASON VALLEY, LYON AND MINERAL COUNTIES, NEVADA, 1948-65,
Geological Survey, Carson City, Nev.
C. J. Huxel, Jr., and E. E. Harris.
Nevada Division of Water Resources Bulletin No 38, 1969. 77 p, 13 fig, 3 plate, 26 tab, 30 ref.

Descriptors: *Water resources development, *Nevada, *Groundwater, Surface waters, Conjunctive use, Water supply, Irrigation water, Water yield, Water wells, Aquifers, Alluvium, Specific capacity.
Identifiers: Mason Valley (Nev).

Mason Valley comprises 510 square miles in the Walker River basin of western Nevada. Precipitation ranges from about 5 inches per year on the valley floor (altitude 4,700-4,300 feet) to about 20 inches in the surrounding mountains. The Mason Valley floor is underlain by a thick sequence of alluvium and fan deposits that form the principal aquifer in the valley. The alluvium contains sand and gravel with transmissibilities in the range from 50,000 to 200,000 gpd per foot, and specific yields of about 20%. The total amount of water stored in the uppermost 50 feet of saturation is about 1,100,000 acre-feet. East and West Walker Rivers contributed an average of 216,000 acre-feet per year during the period 1948-65. Conjunctive use of surface and groundwater, together with salvage of natural water losses, would yield as much as 100,000 acre-feet per year. (Knapp-USGS)
W70-04098

UNDERGROUND STORAGE OF IMPORTED WATER IN THE SAN GORGONIO PASS AREA, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 04B.
W70-04102

KARST AND ASSOCIATED UNDERGROUND WATERS OF THE SOUTHWESTERN PART OF THE DONETS BASIN (RUSSIAN),
Akademiya Nauk URSR, Kiev. Instytut Geologichnykh Nauk.
B. A. Korzhenevskiy.
In: Trudy Soveshchaniya po Voprosam Kompleksnogo Izucheniya Rezhima Poverkhnostnykh i Podzemnykh Vod v Karstovykh Rayonakh (Proc of Conf on Complex Problems of Surface and Groundwater Systems in Karstic Regions), Upravleniye Gidrometeorologicheskoy Sluzhby, Ukr, SSR, p 60-63, 1969. 4 p.

Descriptors: *Karst, *Aquifers, *Groundwater, *River basins, Geology, Crystalline rocks, Sedimentary rocks, Fissures (Geology), Boreholes, Limestones, Erosion, Weathering.
Identifiers: *USSR, Donets Basin.

General and historical geology are used in analysis of aquifers of the karstic area located in the southwestern part of the Donets Basin. In this area four water-bearing horizons are identified as follows: (1) Crystalline rocks and the products of their weathering; (2) Devonian fissure-bearing rocks (sandstones, slates, conglomerates); (3) Lower Carbonaceous limestones and sands; and (4) Pre-Tertiary sand and clay formations. Karstic processes in this area are associated with the Lower Carbonaceous limestones. (Gabriel-USGS)
W70-04106

GROUNDWATER REGIME OF THE UPPER CRETACEOUS WATER-BEARING HORIZON OF THE LUGANSK REGION (RUSSIAN),
Voroshilovgrad Hydrogeological Station (USSR).
A. P. Rakitina, and M. V. Dvoskin.
In: Trudy Soveshchaniya po Voprosam Kompleksnogo Izucheniya Rezhima Poverkhnostnykh i Podzemnykh Vod v Karstovykh Rayonakh (Proc of Conf on Complex Problems of Surface and Groundwater Systems in Karstic Regions), Upravleniye Gidrometeorologicheskoy Sluzhby, Ukr, SSR, p 84-90, 1969. 7 p, 1 fig, 3 tab, 2 ref.

Descriptors: *Groundwater movement, *Aquifers, *Hydrogeology, Geology, Topography, Water sources, Discharge (Water), Climates, Boreholes, Water level fluctuations, Air temperature, Rivers, Seasonal, Filtration, Floods, Velocity, Precipitation (Atmospheric), Water balance.
Identifiers: Lugansk region, USSR.

The groundwater regime of the Lugansk region was investigated by using the Forchheimer equation and borehole data to calculate the effect of floods on water level fluctuations. The whole region may be considered as a source for the accumulation of the groundwater. The main source of Upper Cretaceous groundwater is the infiltration of atmospheric precipitation. In general, the amplitude of water level fluctuations depends on the amounts of precipitation, evaporation, the thickness of the aeration zone, and permeability. (Gabriel-USGS)
W70-04108

SOME CHARACTERISTICS OF RIVER AND SPRING RUNOFFS IN THE KARSTIC AREAS OF ESTONIA (RUSSIAN),
For primary bibliographic entry see Field 02E.
W70-04109

THE CONTINUITY BETWEEN GROUNDWATER FLOW SYSTEMS AND FLOW IN THE UNSATURATED ZONE,
Department of Energy, Mines and Resources, Calgary (Alberta). Inland Waters Branch.
For primary bibliographic entry see Field 02G.
W70-04113

HYDROLOGICAL DOCUMENTATION FOR THE EXPLOITATION OF RESERVOIRS IN PERMEABLE SOLID ROCKS FOR THE PURPOSE OF ARTIFICIAL INFILTRATION,
Hydraulic Research Inst., Prague (Czechoslovakia).
For primary bibliographic entry see Field 03B.
W70-04118

ARTIFICIAL RECHARGE AND ITS POTENTIAL IN ILLINOIS,
Illinois State Water Survey, Urbana. Hydrology Section.
For primary bibliographic entry see Field 04B.
W70-04119

ARTIFICIAL CONTROL OF STATIC FISSURE-KARST WATER RESOURCES IN CARBONATE ROCKS,
All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
For primary bibliographic entry see Field 04B.
W70-04120

ARTIFICIAL RECHARGE OF WATER THROUGH WELLS: EXPERIENCE AND TECHNIQUES,
For primary bibliographic entry see Field 04B.
W70-04122

A CONTRIBUTION TO THE TECHNIQUE FOR EVALUATION OF NATURAL AND WORKABLE RESOURCES OF NEAR-CANAL FRESHWATER LENSES,
Moscow State Univ. (USSR); and All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
V. M. Shestakov, and I. P. Kravchenko.
Artificial Recharge and Management of Aquifers, Symposium of Haifa, Mar 19-26, 1967, International Association of Scientific Hydrology, Publication No 72, p 83-90, 1967. 8 p, 2 fig, 1 tab, 6 ref.

Descriptors: *Seepage, *Canals, *Recharge, *Analog models, Aquifers, Aquicludes, Model studies, Hydrogeology, Discharge (Water), Water yield, Water wells, Infiltration, Groundwater movement, Saline water intrusion.
Identifiers: *USSR.

The fresh-water lenses which are formed near large canals are as a rule hydraulically connected with the canal and located immediately over an aquicludes. For such conditions, a technique is presented for evaluating the workable resources when a linear water intake is located along canals. Analytical calculation methods and application of the modelling methods are described. For the 'hanging' lenses, approximate methods of calculation and methods of modelling, using solid and net-like electrical models, are presented. Also, the technical problems of hydrogeological investigations required for determining the initial hydrogeological parameters are discussed. (Knapp-USGS)
W70-04123

ON THE STORAGE COEFFICIENT OF FREE SURFACE AQUIFERS, CONSIDERING THE FLOW IN THE UNSATURATED ZONE (FRENCH),
Grenoble Univ. (France).
For primary bibliographic entry see Field 02G.
W70-04124

ARTIFICIAL RECHARGE THROUGH AUGMENTED BANK STORAGE,
Princeton Univ., N.J. Dept. of Civil and Geological Engineering.
For primary bibliographic entry see Field 04B.
W70-04125

GEOLOGIC AND HYDROLOGIC FACTORS RELATED TO ARTIFICIAL RECHARGE OF THE CARBONATE-ROCK AQUIFER SYSTEM OF CENTRAL ISRAEL,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 04B.
W70-04126

THE SPREADING PATTERN OF INJECTED WATER IN A PERMEABILITY STRATIFIED AQUIFER,
Water Planning for Israel Ltd., Tel Aviv.
For primary bibliographic entry see Field 04B.
W70-04127

ELECTROMODELLING AS AN EFFECTIVE METHOD OF PROGNOSTICATING RESOURCES OF UNDERGROUND WATER DURING THEIR REPLENISHMENT,
For primary bibliographic entry see Field 07C.
W70-04128

A GENERALIZED THEORY ON HYDRODYNAMIC DISPERSION IN POROUS MEDIA,
Technion - Israel Inst. of Tech., Haifa; and Water Planning for Israel Ltd., Tel Aviv.
J. Bear, and Y. Bachmat.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (Mar 19-26, 1967), International Association of Scientific Hydrology, Pub No 72, p 7-16, 1967. 10 p, 3 ref.

Descriptors: *Dispersion, *Flow, *Porous media, *Groundwater movement, *Tracers, Dye releases, Salts, Ion transport, Diffusion, Mathematical models, Mass transfer, Solutes, Aqueous solutions.
Identifiers: Hydrodynamic dispersion.

The phenomenon of hydrodynamic dispersion occurs in problems of underground mixing of waters of different quality. In these problems, any identifiable solute may serve as a tracer if its concentration distribution indicates the mixing. A review is given of the microscopic and macroscopic factors of the medium and the liquid, which affect the mixing phenomenon. A generalized macroscopic dispersion theory is based on the hydrodynamics of the microflow through a porous medium model and on statistical averaging procedures. The macroscopic parameters appearing in the averaged transport equations and their interrelations are analyzed. The problem of determining the tracer concentration distribution under field conditions is stated mathematically in the form of a set of equations with boundary and initial conditions. (Knapp-USGS)
W70-04129

GROUNDWATER FLOW SIMULATED ON COMPUTER AIDS NUCLEAR PLANT RADIOACTIVE WASTE STUDY,
Battelle-Northwest, Richland, Wash. Water Resources Systems Section.
For primary bibliographic entry see Field 05B.
W70-04309

HYDROGEOLOGICAL CONDITIONS OF THE TARKHANKUT KARSTIC DISTRICT OF CRIMEA (IN RUSSIAN),
Ye. V. L'vova.
In: Trudy Soveshchaniya po Voprosam Kompleksnogo Izucheniya Rezhima Poverkhnostynykh i Podzemnykh Vod v Karstovykh Rayonakh (Proc of Conf on Complex Problems of Surface and Groundwater Systems in Karstic Regions), Upravleniye Gidrometeorologicheskoy Sluzhby, Ukr, SSR, p 49-54, 1969. 6 p, 4 fig, 9 ref.

Descriptors: *Hydrogeology, *Mountains, *Karst, Sedimentary rocks, Carbonates, Geology, Mapping, Limestones, Sands, Sandstones, Water chemistry, Discharge (Water), Aquifers, Water supply, Water pollution, Geomorphology.
Identifiers: *USSR, Crimean karstic area.

The general hydrogeological conditions in the karstic district of Crimea are discussed on the basis of geological, geochemical, and hydrological information. The geological history of the district, a number of hydrogeological profiles, and the distribution and chemical composition of aquifers in Western Crimea are summarized. (Gabriel-USGS)
W70-04312

UNDERGROUND WATER REGIME OF THE MAIN RIDGE OF THE CRIMEAN MOUNTAINS (IN RUSSIAN),
Crimean Landslide and Hydrogeological Station (USSR).
G. D. Neklyudov.
In: Trudy Soveshchaniya po Voprosam Kompleksnogo Izucheniya Rezhima Poverkhnostynykh i Podzemnykh Vod v Karstovykh Rayonakh (Proc of Conf on Complex Problems of Surface and Groundwater Systems in Karstic Regions) Upravleniye Gidrometeorologicheskoy Sluzhby, Ukr, USSR, p 43-48, 1969. 6 p, 2 ref.

Descriptors: *Hydrogeology, *Hydrologic budget, *Aquifers, *Water supply, *Mountains, Boreholes, Water levels, Geology, Precipitation (Atmospheric), Forecasting, Forests, Snow, Geomorphology, Discharge (Water), Infiltration, Karst, Water chemistry, Springs.
Identifiers: *USSR, Crimea.

Discharge regime water level fluctuations, atmospheric precipitation, discharge forecasting, the effect of artificial factors (forest plantations) and geology of the Crimean Mountains are discussed on the basis of data recorded at 182 natural springs and 53 boreholes. The water balance regime of the Main Ridge is computed. (Gabriel-USGS)
W70-04313

BASIC HYDROGEOLOGIC DATA, PINE RIDGE INDIAN RESERVATION, SOUTH DAKOTA,
Geological Survey, Vermillion, S. Dak.
Donald G. Adolphson, and Michael J. Ellis.
South Dakota Geological Survey Water Resources Report No 4, 1969. 75 p, 2 fig, 7 tab, 91 ref.

Descriptors: *Water resources, *Data collections, *South Dakota, Water wells, Streamflow, Springs, Water quality, Hydrogeology, Hydrologic data, Aquifers, Streams, Water yield, Water supply.
Identifiers: Pine Ridge Indian Reservation (S Dak).

Basic hydrological data collected in the Pine Ridge Indian Reservation, South Dakota, are tabulated. The data collected include records of wells and springs, chemical analyses, streamflow, runoff, low-flow, and lithologic logs of wells. (Knapp-USGS)
W70-04314

MOJAVE RIVER BASIN GROUNDWATER RECHARGE WITH PARTICULAR REFERENCE TO THE CALIFORNIA FLOODS OF JANUARY AND FEBRUARY 1969,
Geological Survey, Menlo Park, Calif.
William F. Hardt.
Geological Survey Open-file Report, Dec 17, 1969. 13 p, 3 fig, 2 tab, 5 ref.

Descriptors: *Recharge, *Alluvium, *California, *Floods, Water spreading, Surface-groundwater relationships, Infiltration, Flooding, Water levels, Water level fluctuations, Hydrographs, Hydrologic budget, Water balance, Evapotranspiration.
Identifiers: Mojave River (Calif).

The floods of January and February 1969 in the Mojave River basin, California caused about $6 to $12 million damage. The floods also produced substantial benefits in recharge of the underlying aquifer at no capital cost. Aquifer recharge from March 1967 through March 1969 was about 300,000 acre-feet from surface flow in the Mojave River between The Forks and Afton Canyon. During the study period, consumptive use and pumping adjacent to the river was about 190,000 acre-ft. About 210,000 acre-ft of floodflow from January through March 1969 recharged the aquifer. This was the equivalent of about 2 years of normal water use. The change in storage for the basin was a net accretion of about 110,000 acre-ft. The value of the recharged water was about $18 million for the 25-month period. Consideration might be given to artificial diversion of controlled floodflow for recharge to the basin. Groundwater pumpage in the basin exceeds average natural recharge from flow in the Mojave River. Floodflows are highly unpredictable and give only temporary relief to the long-term continuous lowering of water levels. (Knapp-USGS)
W70-04323

DIFFUSION FROM A GASEOUS SOURCE IN A POROUS MEDIUM - A FIELD AND THEORETICAL COMPARISON,
Geological Survey, Idaho Falls, Idaho.
John B. Robertson.
Available from Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $3.75 per copy. Geological Survey Research 1969, Professional Paper 650-D, p D265-D273, 1969. 9 p, 5 fig, 5 ref.

Descriptors: *Diffusion, *Porous media, Groundwater movement, Tracers, Tracking techniques, Radioisotopes, Gases, Mathematical studies, Model studies, Laboratory tests.
Identifiers: *Gaseous diffusion, Tracer dispersion.

Small volumes of air containing a radioactive krypton-85 tracer were injected into fine-grained sediments at the National Reactor Testing Station, Idaho. Dissipation of the Kr-85 gas away from the injection points was observed by recording the gamma radioactivity in the holes. A mathematical model was adapted from a heat-flow analogy to estimate the amount of molecular diffusion occurring in the system. The observed field data match the theoretical diffusion curves closely, indicating that most of the observed outflow was due to diffusion. (Knapp-USGS)
W70-04338

TWO-DIMENSIONAL DISPERSION IN A GRANULAR-MEDIUM DISK SOURCE EMITTING AT CONSTANT RATE,
Geological Survey, Honolulu, Hawaii.
Akio Ogata.
Available from Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $3.75 per copy. Geological Survey Research 1969, Professional Paper 650-D, p D260-D264, 1969. 5 p, 11 ref.

Descriptors: *Groundwater movement, *Dispersion, *Tracers, *Mathematical studies, Mathematical models, Model studies, Flow, Porous media, Diffusion, Tracking techniques, Mass transfer, Convection, Ion transport.
Identifiers: Tracer dispersion.

A solution of the two-dimensional differential equation of dispersion from a disk source is developed utilizing a point-source solution which appears frequently in heat-transfer problems. Because of the complexity of the solution, expressions applicable along a given axis were obtained to facilitate computation of the dispersion coefficients for a given laboratory test. (Knapp-USGS)
W70-04339

EXPLOITATION TEST ON THE SUB-ALLUVIAL AND SUB-FLUVIAL MEUSE GROUNDWATER TO THE NORTH OF VERDUN (IN FRENCH),
For primary bibliographic entry see Field 04B.
W70-04351

ARTIFICIAL RECHARGE BY INDUCED INTERAQUIFER LEAKAGE,
Geological Survey, Columbus, Ohio.
For primary bibliographic entry see Field 04B.

W70-04352

RECHARGE AND WATER INJECTION IN UNDERGROUND AQUIFERS (IN FRENCH),
For primary bibliographic entry see Field 04B.
W70-04353

COMPARISON OF LABORATORY AND FIELD ANALYSES OF AQUIFER AND WELL CHARACTERISTICS AT AN ARTIFICIAL RECHARGE WELL SITE,
Geological Survey, Denver, Colo.; and Geological Survey, Little Rock, Ark.
A. I. Johnson, and R. T. Sniegocki.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 182-192, 1967. 11 p, 4 fig, 14 ref.

Descriptors: *Artificial recharge, *Recharge wells, Surveys, Aquifers, Observation wells, Alluvium, Sands, Gravels, Laboratory tests, Permeability, Transmissivity, Particle size, Storage coefficient, Specific capacity.
Identifiers: *Aquifer testing, Pumping tests.

Research on artificial recharge of alluvial deposits by means of recharge wells was carried out in the Grand Prairie region of Arkansas. Extensive test-drilling and construction of observation wells within the 24sq mi research site provided detailed information on the geology and hydrology of the deposits of Quarternary Age. Aquifer characteristics were determined by means of laboratory analysis of samples collected from the pilot test holes for the recharge wells and by conventional pumping-test in the field. On the basis of the laboratory analyses, a transmissibility of 60,000 gpd/ft, and a storage coefficient of 0.34 was predicted for the recharge test site. Later pumping tests and recharge tests in the field confirmed that the values of transmissibility predicted from laboratory analysis were comparable to those obtained by the field test. Slow drainage from the fine-textured portions of the aquifer resulted in a change in storage coefficient with time. However, the field data showed that the storage coefficient probably would have reached the value predicted by laboratory analyses if the field test had been run for a much longer period of time. (Knapp-USGS)
W70-04354

HYDROGEOLOGICAL INVESTIGATIONS AND ESTIMATION OF FRESH GROUNDWATER RESOURCES IN COASTAL AREAS,
All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
V. D. Babushkin, and V. M. Goldberg.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 383-389, 1967. 7 p, 1 ref.

Descriptors: *Hydrogeology, *Aquifers, *Coasts, *Saline water-freshwater interfaces, *Surveys, Water resources development, Water management (Applied), Saline water intrusion.
Identifiers: Coastal fresh-water lenses.

The hydrogeological conditions of coastal fresh groundwaters are discussed and characterized schematically. The principles of estimating the exploitation resources of coastal fresh groundwater are given, salt water encroachment is taken into account, and design factors of concentrated and linear water intakes are presented. The problems of hydrogeological investigations, and the techniques of exploration and estimation of fresh groundwater resources in coastal areas are discussed. (Knapp-USGS)
W70-04357

USE OF AIR TO INFLUENCE GROUNDWATER MOVEMENT,
Dames and Moore, San Francisco, Calif.
George D. Roberts.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 390-398, 1967. 9 p, 4 fig, 5 ref.

Descriptors: *Saline water intrusion, *Aquifers, *Coasts, *Groundwater barriers, Groundwater movement, Water management (Applied), Aeration, Saturation, Unsaturated flow.
Identifiers: *Saline water barriers, Air barriers, Saline water intrusion control.

Air may be utilized as a barrier to the migration of saline, or other contaminated waters, where the proper permeability and geologic structure conditions are present. The advantages of an air barrier are: the availability of air, which eliminates the need for pipelines or other means of water conveyance to injection wells; the ease of maintaining the air barrier; and the comparatively low cost of the operations. The great variety of topography, stratigraphy, structural conditions, permeability, and the depth at which the barrier is to be installed and maintained will all have important effects upon the design and operation of such an installation. The well-developed techniques employed to repressurize oil and gas fields, as well as those for the storage of 'off-peak' natural gas in natural underground reservoirs from transmission lines, are reviewed. All who have been afflicted with an air-locked well will attest to the effectiveness of air in decreasing the permeability. Some laboratory data are presented which indicate the effectiveness of air under varying pressures and permeability. (Knapp-USGS)
W70-04358

HYDROGEOLOGICAL STRUCTURES AND WATER RESOURCE REGULARIZATION (IN FRENCH),
For primary bibliographic entry see Field 04B.
W70-04360

GROUNDWATER LEVELS IN NEW MEXICO, 1965, AND CHANGES IN WATER LEVELS, 1961-1965,
Geological Survey, Washington, D.C.
F. E. Busch, and J. D. Hudson.
New Mexico State Engineer, Technical Report 34, 1967. 124 p, 44 fig, 40 tab, 49 ref.

Descriptors: *Water levels, *New Mexico, *Irrigation effects, *Groundwater, *Drawdown, Watersheds (Basins), Water table, Observation wells, Hydrologic data, Monitoring, Data collections.
Identifiers: *Periodic measurements.

Periodic water level measurements in New Mexico are taken in a network of observation wells in areas of heavy groundwater use. There are about 1,500 of these wells in seven major drainage basins or groups of basins. An estimated 90% of all groundwater use in New Mexico is for irrigation. Of the 1,063,000 acres irrigated in the state in 1965, about 587,000 acres were irrigated with groundwater only, 150,000 acres were irrigated with a combination of surface and groundwater, and 326,000 acres were irrigated with surface water only. Extensive groundwater use for irrigation has lowered water levels in most of New Mexico's irrigated areas. This trend continued during the 1961-65 period. The maximum one-year decline in 1965 was 7 feet and the maximum 1961-65 decline was 53 feet. (Carr-Arizona)
W70-04390

QUANTITATIVE ANALYSIS OF WATER RESOURCES IN THE ALBUQUERQUE AREA, NEW MEXICO; COMPUTED EFFECTS ON THE RIO GRANDE OF PUMPAGE OF GROUNDWATER, 1960-2000,
Geological Survey, Washington, D.C.
H. O. Reeder, L. J. Bjorkland, and G. A. Dinwiddie.
New Mexico State Engineer, Technical Report 33, 1967. 34 p, 5 fig, 2 tab, 11 ref.

Descriptors: *Groundwater movement, *Rio Grande, *Drawdown, *Infiltration, *New Mexico, Hydraulic gradient, River flow, Water table, Water demand, Pumping, Hydrogeology, Sedimentation.
Identifiers: *Albuquerque, New Mexico.

Future lowering of water levels in the Albuquerque area was computed from the basic assumptions of water requirements and aquifer characteristics. The greatest decline in water level - 86 feet - is expected to occur under the east mesa. The most significant anticipated effects of this water-level decline are: (1) the reversal of the water-table gradient east of the Rio Grande, causing groundwater to flow away from the river, and (2) the eastward movement of groundwater from the Rio Grande, increasing the quantity of pumped water derived from the river. Roughly 80% of the water pumped by the city in the 1920-1960 period was derived from the flow of the Rio Grande, but development of new wells distant from the river will keep the percentage from increasing. (Carr-Arizona)
W70-04392

HYDROGEOLOGY OF THE RIO GRANDE VALLEY AND ADJACENT INTERMONTANE AREAS OF SOUTHERN NEW MEXICO,
New Mexico State Univ., University Park. Water Resources Research Inst.
For primary bibliographic entry see Field 02A.
W70-04399

HYDROGEOLOGICAL INVESTIGATIONS IN THE WESTERN CATCHMENT OF THE RED SEA,
Geological Survey of Israel, Jerusalem; and Water Planning for Israel Ltd., Tel Aviv.
A. Arad, and A. Michaeli.
Israel Journal of Earth-Sciences, Vol 16, p 181-197, 1967. 10 fig, 2 tab, 11 ref.

Descriptors: *Hydrogeology, *Aquifers, *Groundwater, *Groundwater recharge, *Geology, Precipitation (Atmospheric), Percolation, Sandstones, Watersheds (Basins), Withdrawal, Water balance, Wells, Geochemistry, Water chemistry, Recharge.
Identifiers: *Israel, *Dead Sea Basin, Hydrogeochemistry.

The hydrogeological study evaluates the groundwater balance of the western catchment of the Dead Sea Basin. The 2700 sq km area receives the major portion of its water by percolation from precipitation in the Judean Hills. It also receives some water from rainstorms in the Judean Wilderness. The annual regimal groundwater recharge amounts to between 70 and 100x10 super 6 cm super 3, but exploitation of the Dead Sea Basin aquifers withdraws more water than is replenished. These aquifers rely primarily on the enormous storage in the Lower Cretaceous Nubian Sandstone formation. As a further complication, long-term precipitation records from Jerusalem show a general quantitative decline in rainfall over the past one hundred years. (Carr - Arizona)
W70-04420

2G. Water in Soils

THE VALIDITY OF SOIL-WATER DIFFUSIVITY THEORY FOR HORIZONTAL WATER ABSORPTION,
Purdue Univ., Lafayette, Ind.
David L. Nofziger.
Master of Science Thesis, Purdue Univ, Jan 1970. 67 p, 2 tab, 15 fig, 40 ref. OWRR Project A-010-IND.

Descriptors: *Soil water, Soil physics, *Soil water movement, Permeability, *Diffusivity, Porous media, *Darcy's Law, *Density bulk, *Gamma rays, Absorption.
Identifiers: Particle movement, *Gamma ray attenuation, Water content gradient, Water flux.

The theory of soil-water diffusivity is normally used to describe absorption of water by a horizontal soil column. Deviations from theory have been noted wherein the water-flux increases more than proportional with the water-content gradient. A study was made for possible cause of these deviations. Transient water-content measurements were made by gamma-ray attenuation. A silt loam soil with both low and high bulk densities showed marked deviations from theory for positions near the water-inlet, but decreased with further-distant positions. Since deviations occurred at both soil densities, the possibility of particle rearrangements being the cause was discarded.
W70-04048

STORM RUNOFF FROM FORESTED CATCHMENTS BY SUBSURFACE ROUTES,
Forest Service (USDA), Columbus, Ohio. Northeastern Forest Experiment Station.
R. Z. Whipkey.
Floods and Their Computation, Proceedings of the Leningrad Symposium, Int'l Assoc Sci Hydrology, p 773-779, Aug 1967.

Descriptors: *Subsurface runoff, *Subsurface flow, *Hydrologic properties, *Hydraulic conductivity, Soils, Permeability, Watershed management, Hydraulics, Hydraulic properties, Hydraulic gradient, Soil physical properties, Soil water movement.

Subsurface stormflow (quick interflow) is a major source of high stream stages from wetted, unfrozen forest soils. Field plot and small watershed studies showed greatest quantities of discharge from fine-textured soils and least from coarse-textured soils which have an inherently greater hydraulic conductivity. Large biological channels, structural planes and channels in fine-textured soils were found to be important water-conduction sources, but their overall importance in watershed discharge is not known. Preliminary plot treatments using subsoiling and trenching techniques to break hydraulic continuum of bedding planes and soil channels reduced subsurface stormflow from the wetted regions above the trenches.
W70-04065

AN EXPERIMENTAL STUDY OF THE UPTAKE OF WATER BY SOYBEAN ROOTS,
Illinois Univ., Urbana. Dept. of Agronomy.
For primary bibliographic entry see Field 02D.
W70-04069

THE INFLUENCE OF FREEZING AND THAWING ON SOIL MOISTURE,
Department of Agriculture, Swift Current (Saskatchewan). Research Station.
For primary bibliographic entry see Field 02C.
W70-04112

THE CONTINUITY BETWEEN GROUNDWATER FLOW SYSTEMS AND FLOW IN THE UNSATURATED ZONE,
Department of Energy, Mines and Resources, Calgary (Alberta). Inland Waters Branch.
R. Allan Freeze.
Proceedings of Hydrology Symposium No 6 on Soil Moisture, Saskatchewan Univ, Nov 15-16, 1967, p 205-240, 1968. 36 p, 7 fig, 1 tab, 34 ref.

Descriptors: *Groundwater movement, *Saturated flow, *Unsaturated flow, *Soil water movement, Infiltration, Evaporation, Groundwater recharge, Equations, Dimensional analysis, Steady flow, Unsteady flow, Compressible flow, Pressure head, Watersheds (Basins), Water level fluctuations.
Identifiers: *Canada, *Saskatchewan, Good Spirit Lake, Soil water-groundwater relationships.

There is a physical and mathematical continuity between unsaturated flow processes of infiltration and evaporation and saturated processes of groundwater recharge and discharge. A generalized flow equation which describes both saturated and unsaturated flow is derived. From this equation, it is possible to develop the one, two, or three-dimensional forms of the steady or unsteady flow equations for saturated or unsaturated flow of a compressible or incompressible fluid through a nonhomogeneous, anisotropic porous medium. The solutions for one-dimensional, vertical, unsaturated, and unsteady flow are reviewed. A mathematical model was developed to examine the mechanisms which control the continuous moisture flow from the soil surface to a point within the groundwater flow pattern. It is shown that the pressure head, total head, and moisture content profiles in the unsaturated zone are dependent upon the conditions of groundwater recharge and discharge. Water table fluctuations result when the rate of groundwater recharge or discharge is not matched by the rate of infiltration or evaporation in the unsaturated zone. Measurements at a recharge-discharge site in the Good Spirit Lake drainage basin, Saskatchewan, appear to be in accord with the theoretical treatment. (Carstea-USGS)
W70-04113

SOIL MOISTURE - INSTRUMENTATION, MEASUREMENT AND GENERAL PRINCIPLES OF NETWORK DESIGN,
Guelph Univ. (Ontario). Dept. of Soil Science.
K. M. King.
Proceedings of Hydrology Symposium No 6 on Soil Moisture, Saskatchewan Univ, Nov 15-16, 1967, p 269-285, 1968. 17 p, 55 ref.

Descriptors: *Soil moisture, *Instrumentation, *Nuclear moisture meters, *Moisture content, *Moisture tension, Infiltration, Runoff, Soil moisture meters, Storage, Evapotranspiration, Soil water movement, Dissolved solids, Groundwater recharge, Analytical techniques, Tensiometers, Gamma rays, Electrical resistance.
Identifiers: Neutron scattering method, Gamma ray attenuation.

Various instruments and techniques may be used to measure the status of water in soil. Several of these are described and evaluated. For inventory purposes, it is necessary to know the change in soil moisture content of the root zone and the flow of water into and out of this zone. The neutron scattering method appears to be the best available for determination of soil moisture content on a network basis. Possible errors in the method are described in detail and suggestions and precautions are given on its use for field measurements. (Carstea-USGS)
W70-04115

APPLICATION OF THERMODYNAMICS TO SOIL MOISTURE,
Saskatchewan Univ. (Saskatoon). Dept. of Soil Science.
E. De Jong.
Proceedings of Hydrology Symposium No 6 on Soil Moisture, Saskatchewan Univ, Nov 15-16, 1967, p 25-49, 1968. 25 p, 2 fig, 3 tab, 25 ref.

Descriptors: *Soil moisture, *Thermodynamics, *Thermodynamic behavior, *Soil water movement, Free energy, Capillary water, Surface waters, Entropy, Enthalpy, Equations, Moisture tension.
Identifiers: *Soil water retention curves, Linear phenomenological laws, Onsager's reciprocal relationships.

A brief review is given of the fundamental equations of thermodynamics and the theory is then extended to the retention and movement of water in soils. At equilibrium, the partial molar free energy is the same everywhere and, based on this, a working equation describing the forces of moisture retention is derived. This equation can be used to clarify the principles behind several methods of determining the soil moisture retention curve or determining the capillary potential. If the system is not too far from equilibrium, irreversible thermodynamics, based on the linear phenomenological laws and Onsager's reciprocal relationships, can be used to describe the simultaneous movement of many components. An example of the application of irreversible thermodynamics to fluxes in soils is given and the advantages of this approach over the empirical linear laws are pointed out. (Carstea-USGS)
W70-04117

ON THE STORAGE COEFFICIENT OF FREE SURFACE AQUIFERS, CONSIDERING THE FLOW IN THE UNSATURATED ZONE (FRENCH),
Grenoble Univ. (France).
Georges Vachaud.
English summary included. Artificial Recharge and Management of Aquifers, Symposium of Haifa, Mar 19-26, 1967, International Association of Scientific Hydrology, Publication No 72, p 69-82, 1967. 14 p, 12 fig, 2 tab, 11 ref.

Descriptors: *Specific yield, *Storage coefficient, *Aquifers, Soil water, Permeability, Porosity, Specific retention, Water storage, Water yield, Water level fluctuations, Water table, Unsaturated flow.
Identifiers: Unsaturated zone.

The assumption that specific yield is the volume of water drained from an aquifer when the water table is lowered has no theoretical basis. It neglects flow in the unsaturated zone above the aquifer. During drainage or recharge, the moisture profile above the water table will tend toward a limit given by capillary pressure-moisture content curves. Storage coefficient, the ratio of water yield to volume of soil drained, reaches a constant value after a period of time depending on permeability. Furthermore, the limit is a function of drawdown, and storage is equal to specific yield only for very large drawdown. With equilibrium conditions, the storage coefficient varies, dependent on initial depth of the water table and on drawdown, to a critical depth at which the value of suction is equal to the residual moisture content, and below which the storage coefficient is constant. Values of storage coefficient are plotted against drawdown and initial water table depth for several soils. (Knapp-USGS)
W70-04124

CHANGES IN THE CLAY-WATER SYSTEM WITH DEPTH, TEMPERATURE, AND TIME,
Georgia Inst. of Tech., Atlanta. Water Resources Center.
For primary bibliographic entry see Field 02K.
W70-04295

MEASUREMENT OF ATMOSPHERIC PRESSURE AND SUBSURFACE-GAS PRESSURE IN THE UNSATURATED ZONE OF THE BANDELIER TUFF, LOS ALAMOS, NEW MEXICO,
Geological Survey, Santa Fe, N. Mex.
J. L. Kunkler.
Available from Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $3.75 per copy. Geological Survey Research 1969, Professional Paper 650-D, p D283-D287, 1969. 5 p, 7 fig, 2 ref.

Descriptors: *Pressure, *Gases, *Monitoring, *Waste disposal, *Injection wells, Unsaturated flow, Soil water, Soils, Aquifers, New Mexico, Radioactive wastes, Radioactive waste disposal.
Identifiers: Los Alamos (N Mex), Bandelier Tuff, Gas disposal.

Pressure transducers, power supplies, and potentiometric recorders were assembled into portable pressure-monitoring systems which measured pressures in the field with an accuracy of about 0.3%. The performance of some of the components was affected by fluctuations in field temperatures; hence these components were operated in a constant-temperature chamber. Subsurface-gas pressures responded to changes in the atmospheric pressure to depths of 35 meters in the Bandelier Tuff; the response was completely attenuated at some depth between 35 and 89 m. (Knapp-USGS)

W70-04335

DIFFERENCES IN SOIL CHEMISTRY INDUCED BY EVAPORATION AND FLOW OF GROUNDWATER,
Geological Survey, Denver, Colo.
Reuben F. Miller.
Available from Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $3.75 per copy. Geological Survey Research 1969, Professional Paper 650-D, p D255-D259, 1969. 5 p, 5 fig, 7 ref.

Descriptors: *Water chemistry, *Groundwater, *Surface waters, *Evaporation, *Ion exchange, Groundwater movement, Grasslands, Leaching, Drainage, Runoff, Saline water, Saline water systems, Saline soils, Soil chemistry.
Identifiers: Prairie potholes.

Soil samples from a drainageway between two prairie potholes in North Dakota were analyzed to determine if and how migration of water through and upward from the saturated zone might influence the chemical composition of water flowing from the upper to the lower pond. Water in the unsaturated zone, that apparently achieves capillary equilibrium during the night, subsequently drains back down each day when equilibrium immediately above the water table is disrupted by transpiration. The salinity of water draining back to the water table is apparently increased as a result of transpiration. The proportion of sodium to calcium and magnesium in the water draining back to the water table is increased as a result of ion exchange. These processes produce an increase in both the salinity and proportion of sodium to calcium and magnesium of water arriving at the lower pond from the upper pond. (Knapp-USGS)
W70-04340

PRACTICAL IMPLICATIONS OF WATER REPELLENCY OF SOILS,
Arizona Univ., Tucson. Dept. of Agricultural Chemistry and Soils.
Hasan K. Qashu, and Daniel D. Evans.
Progressive Agriculture in Arizona, Vol 21, No 6, p 3-5, November-December 1969. 3 fig.

Descriptors: *Soil surfaces, *Organic matter, *Surfactants, *Wettability, Soil fungi, Irrigation, Water yield, Mudflows, Soil properties, Citrus fruit, Arizona, Deserts, Orchards.
Identifiers: *Water repellency, *Soil non-wettability, Peat moss.

Water repellency is a surface phenomenon induced by organic chemicals and/or organisms in the soil. Under natural conditions water repellency is caused by one or more of the following: (1) high content of organic matter in surface soil; (2) coating of soil particles by organic chemicals, and (3) high concentration of fungi mycellia. The two major areas of losses due to water repellency problems are probably home gardening and citrus orchards. This is quite often due to incorrect use of peat moss. Another problem area is watersheds that have been burned by wildfire. Water yield is increased, but so is erosion hazard. Mudflows often result. There are several surfactants available to combat water repellency in soils. The buyer should use the following criteria in selecting an appropriate surfactant: (1) efficiency of the chemical in combating water repellency; (2) effective period of the surfactant under local soil and climatic conditions; (3) degradability of the chemical and its residual effects on microbial ecology; and (4) economic and esthetic benefits derived from using the surfactant. More research is needed in the relationship of soil repellency to mechanisms of water transfer in soils. (Carr-Arizona)
W70-04395

SALT AND WATER MOVEMENT INTO SOLONETZIC SOILS,
Department of Agriculture, Lethbridge (Alberta). Research Station.
J. C. van Schaik, and R. R. Cairns.
Canadian Journal of Soil Science, Vol 49, No 2, p 205-210, June 1969.

Descriptors: *Alkaline soils, *Leaching, *Land reclamation, *Infiltration, *Saline water, Arid lands, Water loss, Sodium, Runoff, Evaporation, Ions, Cation adsorption, Capillary action, Penetration, Permeability, Soil horizons.
Identifiers: *Solonetzic soils, Alberta, Canada, Divalent cations.

Water infiltration into an alkaline soil (Duagh silt loam) was greatly increased with the aid of NH sub 4 super plus or divalent cations. An 0.1 N solution penetrated the soil 50 times faster than water. Greatest leaching efficiency occured when the soil was driest. But as long as there is a net annual downward movement of water in the soil, application of cations will cause the sodium to move downward in the soil profile. This treatment could improve penetration of the soil by rainwater and thus reduce runoff and evaporation loss. (Carr-Arizona)
W70-04400

AGRARIAN STRUCTURE IN THE PIEDMONT OASES OF TARAPACA PROVINCE (IN SPANISH),
Universidad Catolica de Valparaiso (Chile). Departamento de Geografia.
For primary bibliographic entry see Field 03F.
W70-04410

HYDROGEOLOGICAL INVESTIGATIONS IN THE WESTERN CATCHMENT OF THE RED SEA,
Geological Survey of Israel, Jerusalem; and Water Planning for Israel Ltd., Tel Aviv.
For primary bibliographic entry see Field 02F.
W70-04420

A STUDY OF CERTAIN PHYSICAL PROPERTIES OF A VERTISOL IN THE GEZIRA AREA, REPUBLIC OF SUDAN,
Food and Agriculture Organization of the United Nations; and Ministry of Agriculture, Wad Medani (Sudan). Soil Survey Div.
A. Zein El Abedine, Glenn H. Robinson, and J. Tyego.
Soil Science, Vol 108, No 5, p 359-366, November 1969. 2 fig, 9 tab, 11 ref.

Descriptors: *Soil physical properties, *Soil types, *Moisture availability, *Hydraulic conductivity, Soil profiles, ARID LANDS, Semiarid climates, Percolation, Seepage, Retention, Particle size, Sodium, Pores, Clays, Density, Soil density probes.
Identifiers: *Vertisols, *Sudan, Exchangable sodium percent (ESP).

The soils of the Gezira area of the Sudanese Central Clay Plain have developed from basaltic parent materials in a semiarid to arid climate. These vertisols, similar to ones in Tanzania and Egypt, are notable for their high water retention. This ranges from 20 to 30% at 15 bars and from 45 to 65% at 0.1 bar. The available moisture levels are positively correlated with the exchangeable sodium percent and range from 45 to 65%, with an average of 21%. The soils have low hydraulic conductivities (from 5 cm/hour to 0.005 cm/hour), with one layer in the profile having relatively much lower conductivity. This appreciably checks the downward passage of water in the soil profile. (Carr - Arizona)
W70-04421

MOISTURE BALANCE IN SOILS OF THE EDMONTON AREA,
Alberta Univ., Edmonton. Soil Science Dept.
T. R. Verma, and J. A. Toogood.
Canadian Journal of Soil Science, Vol 49, p 403-407, October 1969. 3 tab, 10 ref.

Descriptors: *Semiarid climates, *Soil moisture, *Moisture deficit, *Soil types, Soil texture, Evapotranspiration, Storage capacity.
Identifiers: *Moisture balance, Available water capacity, Alberta, Canada.

Due to insufficient precipitation during the growing season, crops of the Canadian Prairies depend heavily on reserve soil moisture. The purpose of the study was to determine the moisture storage capacities of the 22 major soil types in the Edmonton area. The soils were sampled to a depth of 122 cm and found to have available water capacities ranging from 5 to 30 cm. Potential and actual evapotranspiration was estimated and from the data the moisture deficits were determined. Fine-textured soils showed deficits of 2-5.5 cm; medium-textured soils, 3.5-7 cm; and coarse-textured soils, 8-12 cm. Soils with high available water capacity did not show moisture deficits until July or later, but soils with low capacity showed a deficit from the very beginning of the growing season. (Carr - Arizona)
W70-04422

2H. Lakes

PRELIMINARY DETERMINATIONS OF HYDROBIOLOGICAL CONDITIONS IN THE VICINITY OF THE PROPOSED JETPORT AND OTHER AIRPORTS IN SOUTH FLORIDA, JULY 1969,
Geological Survey, Tallahassee, Fla.
For primary bibliographic entry see Field 04C.
W70-04078

A NUMERICAL STUDY OF LARGE-SCALE MOTIONS IN A TWO-LAYER RECTANGULAR BASIN,
Waterloo Univ. (Ontario). Dept. of Mechanical Engineering.
Kenneth B. Yuen.
Manuscript Report Series, No 14, Marine Sciences Branch, Department of Energy, Mines and Resources, Ottawa, 1969. 119 p, 58 fig, 6 tab, 59 ref.

Descriptors: *Great Lakes, *Model studies, *Water circulation, Mathematical models, Winds, Waves (Water), Currents (Water), Lakes, Frequency, Seiches.
Identifiers: Lake circulation.

Large-scale motion in the Great Lakes is predicted through the use of computer-oriented mathematical models. A one-layer one-dimensional model is constructed for Lake Huron. Spatial integration of the hydrodynamical equations by finite-difference techniques yields the frequencies of the lowest longitudinal free barotropic modes of Lake Huron. The power spectral analysis of water level records is carried out to verify these calculated frequencies. A numerical model is constructed for a two-layer rectangular basin of constant depth. The response of the basin under the influence of wind stress is studied. Six cases were investigated, in which the wind stress was impulsive, constant or periodic in time. The behavior of the basin is discussed in terms of theoretical forced and free motions. (Knapp-USGS)
W70-04099

REDUCTION OF ZOOPLANKTON STANDING STOCKS BY PREDACEOUS CYCLOPS BICUSPIDATUS THOMASI IN MARION LAKE, BRITISH COLUMBIA,
British Columbia Univ., Vancouver. Dept. of Zoology; and British Columbia Univ., Vancouver. Inst. of Fisheries.
Donald J. McQueen.
Journal Fisheries Research Board of Canada, Vol 26, No 6, p 1605-1618, 1969. 8 fig, 1 tab, 12 ref.

Descriptors: *Predation, *Standing crop, *Copepods, Feeding rates, Rotifers, Zooplankton, Lakes.
Identifiers: *Marion Lake (British Columbia), Cyclops biscuspidatus, Cladocera, Canada.

Copepodids of stage IV and V and adults of Cyclops biscuspidatus are predators. Predaceous forms appeared in the plankton in April and May, peaked during July and decreased during August of both study years (1966 and 1967). Predaceous forms did not feed on seven forms of algae but did feed on six groups of animals: nauplii I-IV and copepodids I-III of C bicuspidatus, Diaptomus nauplii, Diaptomus copepodids, Cladocera, and rotifers. Laboratory feeding studies yielded high feeding rates of rotifers, Cyclops nauplii and Diaptomus nauplii, and low rates on cladocerans. Studies on predation rates under field conditions showed higher rates for mixtures of Cyclops and Diaptomus nauplii; lower rates for rotifers. Calculations of estimated number of prey eaten (C b nauplii) and surviving prey were 23.9 and 53.4 per liter, respectively; so that 31% of the nauplius production recruited during the summer could have been eaten, assuming feeding rates equal to those of laboratory studies. C b thomasi contributes significantly to mortality of diaptomid nauplii but not to copepodids. (Voightlander-Wisconsin)
W70-04183

PHYTOPLANKTON FROM SWEDISH LAKES. II. LAKE ASSJON 1961-1962,
Uppsala Univ. (Sweden). Inst. of Limnology.
Torbjorn Willen.
Oikos, Vol 20, No 1, p 67-77, 1969. 3 fig, 5 tab, 7 ref.

Descriptors: *Phytoplankton, *Lakes, Chemical analysis, Trophic level, Analysis, Cyanophyta, Chlorophyta, Chrysophyta, Diatoms, Euglenophyta, Pyrrophyta, Temperature, Oxygenation.
Identifiers: *Lake Assjon (Sweden), Peridinae groups, Physical analysis, Phytoplankton volume, Transparency.

This comprehensive qualitative and quantitative investigation of phytoplankton of Lake Assjon, Sweden, embraced an appraisal of about 100 taxonomic groups, including the predominant Chrysophyceae. The study was supplemented by determination of temperature, transparency, pH values, oxygenation, different forms of nitrogen, bases, dissolved and total phosphates, chlorides, sulfates, and carbonic acid. The changes in the volume of phytoplankton of different groups were recorded at monthly or shorter intervals from May 1961 till July 1962. The results of the study were compared with results obtained for Lake Vattern, Lake Sodra Vixen, and several others. The total plankton volume in the studied lakes is usually below five hundred million cubic micron/liter and seldom exceeds one billion cubic micron/liter. (Wilde-Wisconsin)
W70-04185

RELATIONSHIP BETWEEN BACTERIA, NUTRIENTS AND RAINFALL IN SELECTED BODIES OF FRESH WATER,
Florida Inst. of Tech., Melbourne. Univ. Center for Pollution Research.
David D. Woodbridge, and William R. Garrett.
Bulletin of Environmental Contamination and Toxicology, Vol 4, No 5, p 311-319, 1969. 5 fig.

Descriptors: *Bacteria, *Nutrients, *Rainfall, *Fresh water, Lakes, Pollutants, Sampling, Temperature, Dissolved oxygen, Nitrates, Phosphates, Coliforms, Runoff, Chemical properties, Recreation facilities.
Identifiers: Artificial lakes, St Johns River (Fla).

The pollution problem of small, man-made, lakes is increasing. They may act as accumulation points for nutrient material and bacteriological and chemical pollutants. St Johns River, Florida, a natural drainage for a large watershed, was selected as control for this study. Selection of two small lakes was based upon conditions existing in adjacent land areas. One, located in a wooded area, about 1/4 mile from the nearest dwelling; the second, encompassed by a housing development and by business establishments. Canals flow through the housing development into the lake. Analyses were made for dissolved oxygen, nitrate nitrogen, ortho phosphate, and bacteria. Results indicate that relationship between dissolved nutrients such as phosphate and nitrate and indicator bacteria (total coliform) are not simple or direct. Variability in data with time and different bodies of water raises doubts regarding the direct relationship between chemical and bacterial pollutants. Sharp increases in total coliform occurred in both lakes unrelated to rainfall. Total coliform in St Johns River correlate much closer to rainfall; even there several sharp increases in total coliform count occurred not obviously related to rainfall increase. (Jones-Wisconsin)
W70-04189

WHAT'S KILLING OUR LAKES,
Minnesota Univ., Minneapolis. Dept. Soil Science.
Lowell D. Hanson, and William E. Fenster.
Crops and Soils, Vol 22, p 13-15, 1969.

Descriptors: *Lakes, Streams, Fish, Land, Ecosystems, Eutrophication, Oligotrophy, Sewage, Algae, Scum, Weeds, Nutrients, Septic tanks, Effluents, Swamps, Forest soils, Minnesota, Wisconsin, Michigan, Phosphorus, Agricultural watersheds, Organic matter, Sediments, Fertilizers, Water pollution, Snow, Runoff, Drainage water, Grasslands, Soil erosion, Groundwater, Potholes.
Identifiers: *Killing, Animal manures, Lake Minnetonka (Minn), Soil minerals, Plant residues, Morris (Minn), Soil percolation.

Phosphorus sources from agricultural watersheds are soil minerals and organic matter; fertilizers, manures, and plant residues; sewage and sediment. If soil reacts with phosphorus-containing materials, seeping water will be stripped of phosphorus. Snow-melt carries higher amounts of phosphorus than runoff waters during other seasons. Septic tank waste water does not always evaporate as expected and seeps into groundwater and lakes. Bottom sediments serve as a 'phosphorus sink' reducing the explosive biological effects of phosphorus in water. Solution of environmental problems may involve extensive land-forming operations to force soil filtration of runoff water. Immediate improvements can be effected by not spreading manure on sloping frozen land, diverting feedlot and grain storage runoff into seepage areas, and storing manure in areas where runoff is not a problem; large feed lots should be located on level, fine textured soils rather than shoreline slopes of a stream or lake. Location decisions in agriculture will increasingly be guided by pollution control agency regulations and zoning restrictions. Land use planning has long range consequences. Cooperation of soil scientists, agricultural engineers, and farmers' innovative talents will result in quicker solutions. (Jones-Wisconsin)
W70-04193

THE UPTAKE OF ORGANIC SOLUTES IN LAKE WATER,
Uppsala Univ. (Sweden). Inst. of Limnology.
Richard T. Wright, and John E. Hobbie.
Limnology and Oceanography, Vol 10, No 1, p 22-28, Jan 1965. 3 fig, 3 tab, 15 ref.

Descriptors: *Lakes, *Organic matter, *Physiological ecology, Radioactivity techniques, Analytical techniques, Water pollution effects, Phytoplankton, Diffusion, Algae, Bacteria, Eutrophication, Glucose, Carbon radioisotopes, Dinoflagellates, Bioassay, Bioindicators.
Identifiers: *Heterotrophy, *Biological uptake, *Microbial ecology, Maximum uptake velocity, Active transport, Bacterial populations, Algal populations, Heterotrophic potential, Relative heterotrophic potential, Sweden, Enzyme kinetics, Lineweaver-Burk equation, Michaelis kinetics, Flagellates, Lake Erken (Sweden), Acetate, Lake Norrviken (Sweden), Acetate bacteria, Glucose bacteria, Chlamydomonads.

Methods exist for estimating, with radiocarbon (C-14) labelled organic compounds, their assimilation by planktonic microbiota. Based on Lineweaver-Burk modification of Michaelis enzyme kinetics, a modification of those methods is described which gives better estimates of heterotrophic potential, particularly in cases where uptake is mediated via processes of active transport. The treatment yields a linear relationship such that a plot of the expression, (C) (u) (t)/c, versus A has a slope whose inverse estimates maximum uptake velocity (where: C- counts/minute from 1 microcurie C-14 in counting device; u- microcuries added to sample; t- incubation time (hours); c- counts/minute from filtered organisms; A- milligrams/liter of added substrate). Where uptake results from diffusion into cell with instantaneous metabolism of substrate, a diffusion constant can be defined from knowledge of uptake velocities at two different substrate concentrations. Method was tested in two Swedish lakes subject to eutrophication. Over a wide range of substrates, estimates apparently show existence of two uptake mechanisms: a transport system, saturated at low substrate concentrations, and a diffusion process whose velocity increases steadily with increasing substrate. Evidence suggests that bacterial populations are responsible for 'transport-type' phenomena, and algal populations, for uptake by diffusion. (Eichhorn-Wisconsin)
W70-04194

NITROGEN METABOLISM IN LAKES. III. TRACER STUDIES OF THE ASSIMILATION OF INORGANIC NITROGEN SOURCES,
Pittsburgh Univ., Pa. Dept. of Biological Sciences.
Vera A. Dugdale, and Richard C. Dugdale.
Limnology and Oceanography, Vol 10, p 53-57, 1965. 4 fig, 8 ref.

Descriptors: *Lakes, *Nitrogen cycle, *Metabolism, *Tracers, Stable isotopes, Nitrogen compounds, Cycling nutrients, Pennsylvania, Phytoplankton, Water chemistry, Spectrophotometry, Chlorophyll, Nitrogen fixation, Water pollution sources, Water pollution effects, Phosphates, Chlorophyta, Chrysophyta, Cyanophyta, Diatoms, Eutrophication, Analytical techniques, Ammonium compounds, Nitrates.
Identifiers: *Nitrogen (Inorganic), Nitrogen-15, Millipore filtration, Kjeldahl technique, Nitrogen (Nitrate), Nitrogen (Ammonia), Isotope ratios, Sanctuary Lake (Pa), Coleman nitrogen analyzer, Seasonal effects, Mass spectrometry, Chlorophyll a, Nitrogen (Molecular), Linesville Creek (Pa), Phosphorus (Phosphate), Ammonium sulfate, Potassium nitrate.

Introduction of ammonium sulfate and potassium nitrate labeled with heavy nitrogen (N-15) into lake water samples permitted measurement of uptake rates of these nitrogen (N) sources in Sanctuary Lake, Pennsylvania, during a summer. Isotope ratios (N-15/N-14) of particulates, filtered from samples after short incubation periods with labeled compounds, were determined by mass spectrometry. In addition, fixation rates of molecular N-15 in such samples were estimated by techniques previously described and utilized in limnological studies. Fixation rates were compared with concentrations of inorganic N found in surface waters of the lake. Extensive variations in uptake regime observed during the season were probably associated with seasonal changes in the phytoplankton community. In early summer, all three forms (ammonia-N, nitrate-N, molecular N) were taken up rapidly, whereas a second pulse of uptake in late summer consisted predominantly of assimilated molecular N. Availability of N compounds in ambient water apparently does not control uptake in Sanctuary Lake, since all forms were present throughout summer, ammonia-N being most abundant, with concentrations in the range 34-300 micrograms/liter. In natural situations, ammonia-N apparently does not suppress N fixation, but may enhance it. (Eichhorn-Wisconsin)
W70-04196

ASPECTS OF THE LIMNOLOGY OF AN ENDORHEIC AFRICAN LAKE (L CHILWA, MALAWI),
Malawi Univ., Limbe.
Brian Moss, and Joyce Moss.
Ecology, Vol 50, No 1, p 109-118, 1969. 3 fig, 7 tab, 35 ref.

Descriptors: *Lakes, *Rainfall, Salinity, Turbidity, Temperature, Phytoplankton, Algae, Diatoms, Nitrates, Phosphates, Fish, Fish harvest.
Identifiers: *Lake Chilwa (Africa), Lake dynamics, Dry lakes, Eu-phytoplankton, Epipelic algae, Endorheic lakes, Africa, Malawi, Arthrospira platensis, Nitzschia palea, Anomoeoneis sphaerophora, Oscillatoria.

Depending on rainfall distribution, Lake Chilwa, Nyassaland, is subject to wide variations in its water volume and length of shoreline. These alterations are accompanied by corresponding great changes in conductance, concentration of chemical constituents, turbidity, and other water properties. The chemical composition of the lake is further complicated by inflow of salt springs and occasional flooding of the marginal mud flats. In dry periods, plant life of the lake is largely limited to epipelic algae; eu-phytoplankton is present only during a few weeks of the year. At times of high water level, the lake is nearly free from nitrates and inorganic phosphates. Regardless of this, large population of digestible diatoms persists on the sediment surface and fish production is high; in 1964 it was expressed in the annual catch of nearly 10,000 metric tons of merchantable fish. Since 1965 increase in salinity, turbidity, and temperature reduced the fish harvest to almost zero. (Wilde-Wisconsin)
W70-04252

A STUDY OF THE PROFUNDAL BOTTOM FAUNA OF LAKE WASHINGTON,
Washington Univ., Seattle. Dept. of Zoology.
Rudolph N. Thut.
Ecological Monographs, Vol 39, No 1, p 79-110, 1969. 27 fig, 5 tab, 34 ref.

Descriptors: *Benthic fauna, Nitrogen, Phosphorus, Phytoplankton, Diatoms, Zooplankton, Dinoflagellates, Algae, Dissolved oxygen, Hypolimnion, Epilimnion, Lake Erie, Insects, Diptera, Crustacea, Molluscs, Oligochaetes, Gastropods.
Identifiers: *Lake Washington (Wash), Macrofauna, Gyttja, Oscillatoria rubescens, Zurichsee, Filamentous algae, Filamentous blue-green algae, Ocular micrometer, Sucrose-flotation technique, Metalimnion, Bathythermograph, Arthropoda, Chironomidae, Aquatic Oligochaetes.

A review of the macrofauna in the profundal zone of Lake Washington between September 1963 and September 1964 and discussion. Although sewage diversion began in 1963, phosphate and oxygen values indicated the lake was still in the eutrophic phase. Ten stations were chosen at 5-meter depth intervals from 10 to 55 meters and sampled approximately monthly with an Ekman dredge. 24 species were recognized from the profundal zone, each presented separately, with the exception of Oligochacta species, along with their depth and population dynamics throughout the year. The Chironomidae were most numerous of bottom fauna constituents (about 45% of the total). 13 species were found during the study, including predators, deposit-feeders, and filter-feeders. Larvae were most common at the shallow-water stations and became progressively diminished with increase in depth. The Oligochacta comprised about 1/2 of the total number and 1/3 of the total biomass of the profundal fauna. Four species were identified. The Oligochacta were found in the greatest numbers and biomass at the greatest depth sampled; their abundance progressively declined with decrease in depth. Amphipoda and Sphaeridae were present but in smaller numbers. (Haskins-Wisconsin)
W70-04253

DIAGNOSING POLLUTION IN LAKE MINNETONKA,
Minnesota Univ., Minneapolis. Limnological Research Center.
For primary bibliographic entry see Field 05C.
W70-04268

STUDY OF BACTERIA ASSOCIATED WITH MARINE ALGAE IN CULTURE. I. PRELIMINARY DETERMINATION OF SPECIES (FRENCH),
Station Marine d'Endoume, Marseille (France).
B. R. Berland, M. G. Bianchi, and S. Y. Maestrini.
Marine Biology, Vol 2, No 4, p 350-355, 1969. 3 tab, 12 ref.

Descriptors: *Bacteria, *Marine algae, *Cultures, Pseudomonas, Metabolism, Kinetics, Nitrogen compounds.
Identifiers: Species determination, Taxonomy, Flavobacterium, Achromobacter, Gulf of Marseilles, Asterionella japonica, Chaetoceros launderi, Lauderia borealis, Leptocylindrus danicus, Phaeodactylum tricornutum, Stichochrysis immobilis, Vibrio, Morphology, Cultural characteristics, Termary compounds, Macromolecules, Antibiotics, Agarbacterium, Xanthomonas, Micrococcus, Staphylococcus.

Bacteria strains have been isolated from marine algae cultures and assigned tentative genera and species. Observations and tests were conducted using Bergey's manual and specific papers on marine bacteria as taxonomic keys. The genera Pseudomonas, Flavobacterium, and Achromobacter appear most important, based on the number of species. This does not imply that they actually dominate in number of germs and in metabolic importance. A later study will permit determination of the precise nature and division of species which accompany an alga in culture and subsequently the same alga in its natural environment. It may be necessary to use some culture medium more definitive and less plethoric, the medium currently used being too rich in organic matter and not corresponding to conditions of the natural medium of the organisms; the literature shows that their nutritional needs are very simple. The study is undertaken to determine precisely their metabolic needs and how these are satisfied in a culture of algae. (Jones-Wisconsin)
W70-04280

COMPETITION BETWEEN PLANKTONIC BACTERIA AND ALGAE FOR ORGANIC SOLUTES,
Uppsala Univ. (Sweden). Inst. of Limnology.
John E. Hobbie, and Richard T. Wright.
Memorie dell'Instituto Italiano di Idrobiologia, Suppl 18, p 175-185, 1965. 4 fig, 1 tab, 5 ref.

Descriptors: *Competition, *Phytoplankton, *Aquatic bacteria, *Algae, Organic matter, Lakes, Diffusion, Carbon radioisotopes, Chlamydomonas, Bioassays, Water pollution effects, Analytical techniques.
Identifiers: *Organic solutes, *Heterotrophy, Microbial ecology, Sweden, Lake Erken (Sweden), Active transport, Carbon-14, Enzyme kinetics, Glucose, Mechaelis-Menten equation, Acetate, Glycollic acid.

Sophisticated investigative techniques, in addition to the traditional methods of direct counts and enrichment cultures, are required for better understanding of roles of microorganisms in the dynamics of lacustrine metabolism. A problem of current interest is the identification of organic solutes utilized by heterotrophic bacteria and algae, and estimation of their concentrations and uptake rates. Data on assimilation of radiocarbon-labeled organic substrates can be analyzed on bases of theories of diffusion and enzyme kinetics. Such methods are illustrated with data from studies on model cultures (Chlamydomonas and planktonic bacteria) and samples from Lake Erken (Sweden). Measurements of velocity uptake of radioisotope over a range of substrate concentrations reveal two mechanisms: an active transport system, attributable to bacteria, and another system in algae which follows diffusion kinetics. The latter is effective at substrate concentrations above 500 micrograms/liter. In natural waters, bacteria effectively reduce acetate and glucose concentrations below 20 micrograms/liter, apparently effecting drastic limitation of algal heterotrophy. In nature, other compounds are available to algae and higher temperature may increase uptake rates, so that algal heterotrophy is not necessarily precluded. (Eichhorn-Wisconsin)
W70-04284

A NEW METHOD FOR THE STUDY OF BACTERIA IN LAKES: DESCRIPTION AND RESULTS,
North Carolina State Univ., Raleigh. Dept. of Zoology; and Gordon Coll., Wenham, Mass.
John E. Hobbie, and Richard T. Wright.
Mitteilungen Internationale Vereinigung fur Theoretische und Angewandte Limnologie, Vol 14, p 64-71, 1968. 5 fig, 10 ref.

Descriptors: *Lakes, *Bacteria, *Analytical techniques, Water pollution effects, Algae, Ecosystems, Physiological ecology, Aquatic bacteria, Carbon radioisotopes, Enzymes, Kinetics, Photosynthesis, Organic matter, Organic compounds, Metabolism, Bioindicators, Bioassays.
Identifiers: *Heterotrophy, Autotrophy, Carbon-14, Radiocarbon uptake techniques, Glucose, Michaelis-Menten equation, Sweden, Lake Erken (Sweden), Lineweaver-Burk equation, Maximum uptake velocity, Michaelis constant, Lake Norrviken (Sweden), Lake Ekoln (Sweden), Lake Lotsjon (Sweden), Permeases, Chamydomonads, Lappland (Sweden), Acetate, Turnover times.

Although bacteria are important in lacustrine metabolism, details of their population dynamics--including generation times and turnover rates--are poorly understood. Radiocarbon-labeled organic compounds have been used previously to determine heterotrophic potential of natural waters, but concentrations of substrate added have been sufficiently large as to make interpretation of resultant data ambiguous. Based upon theoretical treatment adapted from Lineweaver-Burk modification of Michaelis-Menten enzyme kinetics, and on additions of very low concentrations of labeled organic substrates, a new method for study of bacterial assimilation is described. That derivation yields relationship, $t/f = (K + S)/V) + A/V$. Here, t is incubation time (hours); f, percentage uptake of isotope by organisms; K, constant (similar to Michaelis constant); s, substrate concentration in nature; A, added substrate concentration; V, maximum velocity. Plot of t/f versus A usually results in linear relationship from which can be estimated maximum uptake velocity (V), turnover time, and approximate naturally occurring substrate concentration. Method is illustrated with data from a series of Swedish lakes. During a single year, V may vary by 2 orders of magnitude within one lake; by 4, between lakes. V is also a very sensitive indicator of pollution. (Eichhorn-Wisconsin)
W70-04287

ANNUAL AUTOTROPHIC PRODUCTION OF PHYTOPLANKTON IN LAKE BAIKAL,
K. K. Votintsev, and G. I. Popovskaya.
Translated from Russian. Original p 205-208. Doklady Akademii Nauk SSSR, Vol 176, No 1, p 634-637, 1967. 3 fig, 1 tab, 13 ref.

Descriptors: *Phytoplankton, *Lakes, Organic matter, Seasonal, Algae, Primary productivity, Harvesting of algae, Biomass.
Identifiers: Seasonal distribution, Lake Baikal, Photosynthetic layer, Melosira baicalensis, Gymnodinium baicalense, Cyclotella minuta.

This pioneering survey of organic matter production in Lake Baikal disclosed a wide place-and-time variation in the biomass of phytoplankton, represented largely by Melosira baicalensis,

Cyclotella minuta, and Gymnodinium baicalense. According to preliminary estimates, the lake has an annual productivity of 157 million tons (wet weight) of harvestable algae, and 136 million tons of non-harvestable algae. The study of primary productivity by the 'flask' method, using oxygen, was confined to the upper 25 meters of the photosynthetic layer. The mean annual biomass per surface square meter of this layer approached 7 grams. The ratio of the average annual primary production to the mean annual index of phytoplankton biomass for the entire lake was equal to 464. Previous studies have shown that values for gross photosynthesis are close to those permitting effective productivity of algae. Information on food requirements of main representatives of zooplankton of Lake Baikal th as far is not available. (Wilde-Wisconsin)
W70-04290

SEASONAL CHANGES IN THE LIMNOLOGY OF SOME MEROMICTIC LAKES IN SOUTHERN BRITISH COLUMBIA,
British Columbia Univ., Vancouver. Inst. of Fisheries.
T. G. Northcote, and T. G. Halsey.
Journal Fisheries Research Board of Canada, Vol 26, No 7, p 1763-1787, 1969. 9 fig, 7 tab, 32 ref.

Descriptors: *Seasonal, *Limnology, *Meromixis, *Lakes, Dissolved solids, Density, Chemical properties, Temperature, Ice, Profiles, Dissolved oxygen, Hydrogen ion concentration, Alkalinity, Physicochemical properties, Biological properties, Conductivity, Sulfur bacteria, Sampling, Frequency, Phytoplankton, Zooplankton, Benthos, Light penetration, Hydrogen sulfide, Surfaces, Copepods, Crustaceans, Standing crop, Depth, Rainbow trout, Dissolved solids, Lakes.
Identifiers: *British Columbia, Chemocline, Vertical, Plates, Morphometry, Geographic features, Bottom, Mixolimnion, Monimolimnion, Diatomus connexus, Ceriodaphnia lacustris, Brachionus plicatilis, Keratella, Campylodiscus, Oedoginium, Cladocerans, Transparency, Meromictic lakes.

Seasonal changes in physical, chemical, and biological features are described in four small British Columbia lakes showing different types and degrees of meromixis. A wide range exists in total dissolved solid content between lakes and within specific lakes (surface to near-bottom, in milligrams/liter): Yellow, surface 282, bottom 337; White, 6229-7918; Mahoney, 10,003-86,906; Lyons, 12,116-222,195, but no marked seasonal changes. Yellow Lake meromixis is probably maintained by morphometric features of the lake basin rather than strong chemocline; in the other lakes complete mixing is inhibited by chemical density gradients, those in Mahoney and Lyons being especially sharp. Summer, autumn, winter (under ice), and spring vertical profiles are presented for temperature, dissolved oxygen, pH, alkalinity, specific conductivity, and differences discussed. Lesser detailed physical-chemical characteristics are given. Purple sulphur bacteria occur in Lakes White, Mahoney and Lyons and in the latter two from discrete 'plates' detectable by high frequency echo sounding (confirmed by sampling). Seasonal changes in depth of bacterial plates are considered in relation to some physical and chemical parameters. Phytoplankton, zooplankton, and benthos communities are discussed, based on degree of meromixis shown by the lakes. (Jones-Wisconsin)
W70-04294

ISOTOPIC COMPOSITION AND ORIGIN OF THE ATMOSPHERIC WATER VAPOR IN THE REGION OF LAKE LEMAN (IN FRENCH),
Pisa Univ. (Italy). Lab. of Nuclear Geology.
For primary bibliographic entry see Field 02K.
W70-04304

HETEROTROPHIC BACTERIA IN LAKE MALAREN AND LAKE HJALMAREN,
Uppsala Univ. (Sweden). Inst. of Limnology.
R. Fonden.
Oikos, Vol 20, No 3, p 344-372, 1969. 23 fig, 5 tab, 36 ref.

Descriptors: *Bacteria, Seasonal, Sampling, Coliforms, Depth, Surfaces, Ice, Chlorophyll, Phosphorus, Nitrogen, Zooplankton, Organic matter, Phytoplankton, Primary productivity, Chemical analysis, Conductivity, Temperature, Stratification, Population, Sewage, Industrial wastes, Oxygen, Hypolimnion, Epilimnion, Optical properties, Carbon radioisotopes, Meteorological data, Outlets, Detritus, Density, Daphnia, Grazing, Standing crop, Effluents, Filtration, Fluorescence, Eutrophication, Oligotrophy.
Identifiers: *Coliformic bacteria, *Heterotrophic, *Lake Malaren (Sweden), Lake Hjalmaren (Sweden), YPA-bacteria, Vertical distribution, Horizontal distribution, MPA-bacteria, Chromogens, Morphometric, Transparency, Metalimnion, Holomictic, Escherichia coli, Aerobacter aerogenes, Cyclops, Bosmina, Eudiaptomus, Excretion, Filter-feeding, Transported bacteria.

Vertical, horizontal and seasonal variations of YPA-bacteria in Lakes Malaren and Hjalmaren were investigated. Weekly samples were analyzed for coliformic, MPA- and YPA-bacteria. During summer stratification, highest numbers of YPA-bacteria occurred at 0.5 meters; decreasing at 5 meters and greater depths. No significant differences in vertical distribution of YPA-bacteria were detected in the hypolimnion. Highest bacterial densities were found near towns; lowest at lake centers. Positive correlation was found between UPA-bacterial numbers from surfaces and concentration of chlorophyll a, phosphorus, and nitrogen. Negative correlation was found between bacterial density and depth of water column. Bacteria was prolific in June in Lake Marlaren. During spring and autumn, sampling stations near river outflows showed high and maximal numbers of coliformic and MPA-bacteria in Ekoln Basin. In winter, numbers were low at most stations as were numbers of washed-in bacteria. During summer, density of UPA-bacteria were apparently influenced by filter feeding zooplankton and amount of available organic carbon. Bacterial maxima recorded during summer using a nutrient-poor yeast-extract peptone medium were not recorded on ordinary nutrient agar. Proportion of pigmented bacteria was greatest at the surface during summer, and lowest during winter. (Jones-Wisconsin)
W70-04370

USE OF GLUCOSE AND ACETATE BY BACTERIA AND ALGAE IN AQUATIC ECOSYSTEMS,
Uppsala Univ. (Sweden). Inst. of Limnology.
Richard T. Wright, and John E. Hobbie.
Ecology, Vol 47, No 3, p 447-464, 1966. 10 fig, 3 tab, 45 ref.

Descriptors: *Aquatic bacteria, *Algae, *Ecosystems, Phytoplankton, Lakes, Competition, Organic matter, Diffusion, Cyanophyta, Bioassays, Chlamydomonas, Water pollution, Analytical techniques, Amino acids, Eutrophication, Seston, Diatoms.
Identifiers: *Glucose, *Acetate, *Heterotrophy, Microbial ecology, Carbon-14, Sweden, Lake Erken (Sweden), Active transport, Enzyme kinetics, Michaelis-Menten equation, Lineweaver-Burk equation, Sugars, Fatty acids, Bacterium EY-19, Uptake velocity, Pseudomonas, Bacterium ER-19, Gymodinium inversum, Utermohl technique, Radiocarbon uptake technique, Chlorophyll a, Michaelis constant, Maximum velocity, Transport constant, Turnover time, Lake Norrviken (Sweden), Lake Lotsjon (Sweden), Lake Ekoln (Sweden).

Kinetic analysis of phytoplankton uptake of radiocarbon-labeled organic solutes yields useful information about dynamics of microbial ecology. Tests over wide substrate ranges indicate existence of two uptake mechanisms. Data from differential filtration and experiments with model laboratory cultures of bacteria and algae differentiate between specific transport systems, effective at very low substrate concentrations, attributable to bacteria, and diffusion mechanisms, effective at greater substrate concentrations, operative in algae. Proper treatment of data yields estimates of following kinetic parameters which have ecological significance: maximum velocity of uptake by bacteria, giving information on sizes and functions of their populations; diffusion constant, relating to rate of solute uptake by algae; and turnover times of organic solutes in aquatic environments. Turnover times of glucose and acetate in eutrophic Lake Erken, Sweden, indicates that algal uptake never exceeds 10% of bacterial, although algal biomasses may greatly exceed bacterial. Two new bioassays can employ kinetics of bacterial uptake to measure naturally occurring concentrations of substrates. Acetate and glucose remain at relatively constant levels of 1-10 micrograms/liter in several aquatic habitats. It is postulated that bacteria effectively utilize substrate at these low levels, and thus, prevent heterotrophic growth of algae. (Eichhorn-Wisconsin)
W70-04372

SEASONAL TRENDS IN PHYSICOCHEMICAL FACTORS AND PLANKTON OF A FRESH-WATER FISHPOND AND THEIR ROLE IN FISH CULTURE,
Madurai Univ. (India) Dept. of Zoology.
For primary bibliographic entry see Field 05C.
W70-04376

PRIMARY PRODUCTION AND NUTRIENTS IN OGAC LAKE, A LANDLOCKED FIORD ON BAFFIN ISLAND,
Dalhousie Univ., Halifax (Nova Scotia). Dept. of Biology.
Ian A. McLaren.
Journal Fisheries Research Board of Canada, Vol 26, No 6, p 1561-1576, 1969. 9 fig, 1 tab, 6 ref.

Descriptors: *Primary productivity, *Zooplankton, *Fertilizers, Chlorophyll, Oxygen, Stratification, Fresh water, Analytical techniques, Analysis, Fjords, Nutrients.
Identifiers: *Holocline, Carbon-14, Baffin Island (Canada), Fertilizer trials, Ogac Lake (Canada).

This study was concerned with the effect of fertilization on primary production and zooplankton of Ogac Lake, Canada. To raise concentration of phosphorus and nitrate nitrogen, known amounts of potassium nitrate and diacid potassium phosphate were added to 3 meter-long and 1 meter-diameter polyethylene columns suspended in the middle of the lake between the anoxic and oxygenated layers. Analyses included determination of chlorophyll, phosphorus, nitrite, nitrate, and carbon-14 uptake. The effect of fertilization was expressed in fivefold increase in amount of chlorophyll and in sevenfold increase in primary production. This improvement took place regardless of the fact that some amount of fertilizers was lost by sinking in particulate form, an unavoidable result in highly stratified lakes. Zooplankton grazing was concentrated at the holocline and deep water and apparently had little influence on the production pattern of the lake. In summer, inflow of fresh water into the narrow zone of Ficus at 2-3 meters killed much of the fauna, thereby augmenting the supply of nutrients. (Wilde-Wisconsin)
W70-04446

EFFECTS OF CONTROLLED NUTRIENT DILUTION OF A EUTROPHIC LAKE,
Seattle, Wash.
For primary bibliographic entry see Field 05C.
W70-04451

FOOD OF LAKE TROUT IN LAKE TAHOE,
Nevada Fish and Game Dept., Reno; and California State Dept. of Fish and Game, Sacramento. Inland Fisheries Branch.
Ted C. Frantz, and Almo J. Cordone.

California Fish and Game, Vol 56, No 1, p 21-35, 1970. 8 tab, 30 ref.

Descriptors: *Fish, *Food habits, *Fish diets, *Lake trout, Sculpins, Fish food organisms, California, Nevada, Amphipoda, Crayfish, Daphnia, Insects, Larvae, Oligochaetes.
Identifiers: *Lake Tahoe (Calif), Cladocera, Ostracoda, Plecoptera, Tenipedae.

Stomachs of 1389 lake trout of five size groups were analyzed. Samples were obtained by creel census, gill-net and bottom trawl. Percentage of empty stomachs increased directly with fork length of fish. Fish under 5 inches utilized cladocerans and copepods (over 90% by weight and frequency of occurrence); tendipid larvae and pupae were of secondary importance. Fish (sculpin) became an important dietary component in fish 5 to 9.9 inches; cladocerans and tendipeds were of secondary importance and amphipods assumed importance. Fish and cladocerans remained important in fish 10 to 14.9 inches, fish other than sculpins and including small lake trout were ingested. Sculpins dominated diet of fish 15 to 19.9 inches; importance of cladocerans diminished while importance of crayfish increased. Fish over 19.9 inches relied almost entirely on fish, primarily suckers. Percentage of stomachs containing food was highest in spring and summer, lowest in winter and autumn for all size groups; mean weight of food per stomach was also highest in spring and summer. Fish were utilized most in spring months, least in summer. Tabular data include seasonal stomach analyses by size group of lake trout. (Voigtlander-Wisconsin)
W70-04452

THE FUTURE OF THE LAKE,
Washington Univ., Seattle. Dept. of Zoology.
For primary bibliographic entry see Field 05C.
W70-04455

THE DEVELOPMENTAL HISTORY OF BLELHAM TARN (ENGLAND) AS SHOWN BY ANIMAL MICROFOSSILS, WITH SPECIAL REFERENCE TO THE CLADOCERA,
Indiana Univ., Bloomington. Dept. of Zoology.
Rodney V. Harmsworth.
Ecological Monographs, Vol 38, No 2, p 223-241, 1968. 9 fig, 4 tab, 91 ref.

Descriptors: *History, *Animals, *Microorganisms, Midges, Sediments, Pollen, Paleolimnology, Bogs, Peat, Glaciers, Organic matter, Temperature, Indicators, Cyanophyta, Oligotrophy, Eutrophication, Zooplankton, Phytoplankton, Chemical analysis, Daphnia, Stratigraphy, Mud, Clays, Littoral, Arctic, Sub-arctic, Temperate, Humic acids, Rotifers, Copepods.
Identifiers: *Microfossils, *Cladocera, *Blelham Tarn (England), Neorhabdocoeles, Bythotrephes, Lake Windermere (England), Chydoridae, Sida, Bosminidae, Bosmina coregoni, Bosmina longirostris, Tanytarsus, Sergentia, Chironomus, Polyphemus, Crooked Lake (Ind), Madison (Wis), Egg-capsules, Ceriodaphnia, Sphagnum, Chydorus sphaericus, Chydorus ovalis, Leptodora, Acroperus harpae, Esthwaite Water (England), Tuberculate Cladocera.

Two cores were taken from Blelham Tarn, 'A,' from a peat bog containing both Lateand Post-glacial sediments, and, 'B,' from deep water containing only Post-glacial sediments. The Cladocera were analyzed qualitatively and quantitatively. Nine species of non-chydorid Cladocera and 24 species of Chydoridae were found. In 'A' two marked periods of abundance occurred in the Allerod and in the Preboreal, with few remains in the Older and Younger Dryas. Periods of abundance coincided with maxima in organic sediment content, and higher temperatures as deduced from stratigraphic distribution of chydorids. Few remains were found in upper peat section of 'A,' but distribution gave evidence of periodic lake level changes. 'B' showed marked changes in abundance of planktonic community, presumably correlated with changes occurring in the peat section of 'A.' Typological succession was followed in the Post-glacial by means of indicator organisms, especially Bosmina coregoni, which gave way to B longirostris in Sub-atlantic period. Midges were analyzed in 'B' and replacement of a predominantly Tanytarsus-Sergentia community by Chironomus occurred shortly before the change-over in the Bosmina species. The neorhabdocoeles, egg-capsules well preserved in lake sediments, are described. Their stratigraphy showed no obvious relationship to other lake events. (Jones-Wisconsin)
W70-04459

PRODUCTIVITY OF OWIKENO LAKE, BRITISH COLUMBIA,
Fisheries Research Board, Nanaimo (British Columbia). Biological Station.
David W. Narver.
Journal Fisheries Research Board of Canada, Vol 26, No 5, p 1363-1368, 1969. 2 tab, 9 ref.

Descriptors: *Primary productivity, *Fish, *Salmon, *Growth rates, *Food chains, Radioactivity technique, Dissolved solids.
Identifiers: Owikeno Lake (British Columbia), British Columbia, Canada, Sockeye salmon, Chlorophyll a, Fish production, Lake Chignik (Alaska), Lake Karluk (Alaska), Lake Igushik (Alaska), Black Lake (Alaska), Babine Lake (British Columbia).

Primary production was measured at two stations on two dates in Owikeno Lake, British Columbia. Mean carbon assimilated per 4 hours was 11 milligrams/square meter (range 2.57 to 30.23) and 1.8 milligrams/cubic meter (range 0.62 to 3.33). Mean chlorophyll a was 0.9 milligrams/cubic meter (range 0.27 to 1.34). Measurements of assimilated carbon were higher in June, chlorophyll a was greater in September. Owikeno has a low primary production rate compared with other major sockeye-producing lakes; probable factors involved include high turbidity and low total dissolved solids. Significance of primary productivity measurements relative to rearing capacity of lake for juvenile sockeye is unknown, but slow growth rate of juveniles may be due to retarded rate of energy transfer through the phytoplankton-zooplankton-sockeye food chain. Tabular data include all measurements in Owikeno Lake and comparison of salmon returns and productivity measurements for six lakes, including Owikeno. (Voigtlander-Wisconsin)
W70-04464

OUTWITTING THE PATIENT ASSASSIN: THE HUMAN USE OF LAKE POLLUTION,
Northwestern Univ., Evanston, Ill. Technological Inst.
For primary bibliographic entry see Field 05C.
W70-04465

DEVELOPMENT OF A MATHEMATICAL MODEL FOR PREDICTION OF TEMPERATURE IN DEEP RESERVOIRS-PHASE II: HIGH DISCHARGE-VOLUME RATIO RESERVOIRS,
Water Resources Engineers, Inc., Lafayette, Calif.
For primary bibliographic entry see Field 06A.
W70-04473

THE EFFECT OF IMPOUNDMENTS ON NATURAL WATERS (IN GERMAN),
Akademiya Nauk SSSR, Leningrad (USSR).
W. I. Shadin.
Verh. Internat. Verein, Limnol., Vol. IV, p 792-805, July 1961.

Descriptors: *Lakes, *Reservoirs, Zooplankton, Phytoplankton, Temperature, *Epilimnion, *Hypolimnion, Algae, Fungi, Bacteria, Fish, Limnology, Hydrologic aspects, Aquatic environment, Water properties, Biological properties, Ecology, Stratification.
Identifiers: Water quality properties.

The building of impoundment qualitatively changes the biological and ecological system of water. A survey of response of water quality to the building of reservoirs and review of water quality properties in lakes and reservoirs in different geologic and climatic conditions is presented in the paper. The water quality and biological system of water in impoundment is dependent on many factors, such as hydrologic regime, climatic and regional conditions, purpose of reservoir, etc. The temperature distribution influences the detention (through-flow) time and formation of density layers with different water quality parameters. The chemical regime is mainly dependent on sludge formation. The amount of bacteria in water has two maximums during a year. The formation of zooplankton and phytoplankton is further discussed. The paper was presented as a leading lecture at XIV-th International Limnological Conference in 1961. (Novotny-Vanderbilt)
W70-04475

PREDICTION OF THERMAL ENERGY DISTRIBUTION IN DEEP RESERVOIRS,
Water Resources Engineers, Inc., Walnut Creek, Calif.
G. T. Orlob, and L. G. Selna.
Proceedings of the Annual Sanitary and Water Resources Engineering Conference, Technical Report No. 6, in Sanitary and Water Resources Engineering, Vanderbilt University, 1967. p 64-77, 1967. 8 fig, 3 ref.

Descriptors: *Thermal stratification, *Mathematical models, *Reservoirs, *Temperature, Thermocline, Heat transfer, Energy transfer, Digital computers, Diffusion, Epilimnion, Hypolimnion, Impoundments, Thermal conductivity, Tennessee Valley Authority Project, California, Lakes.

A mathematical model for simulation of thermal energy distribution (temperature) in impoundments is presented. Assumptions are made and justified concerning the one-dimensional approach to structuring the model, the nature of the heat transfer (eddy diffusion) coefficient, and selected boundary conditions. An example, derivation of the transfer coefficient A (z,t) from actual field data is presented and interpreted to show the limiting nature of the thermocline in energy transfer in the vertical and the nature of mixing in the epilimnion and hypolimnion. Results of a hypothetical test case for a reservoir receiving a natural runoff, including snow melt, are given and qualitatively compared to observed behavior of actual reservoirs. (Novotny-Vanderbilt)
W70-04476

TEMPERATURE CONTROL OF RESERVOIR RELEASES INTO NOLIN AND BARREN TAILWATERS,
Department of Fish and Wildlife Resources, Ky.
J. P. Carter.
Project, Department of Fish and Wildlife Resources, Kentucky, 1968. 36 p, 14 tab., 3 fig., 8 ref.

Descriptors: *Temperature, *Reservoirs, *Fishing, Electro-fishing, Fish harvest, *Temperature control, Thermal stratification, Thermal properties, Reservoir operation, Fish management, Limnology, Kentucky.
Identifiers: Kentucky reservoirs.

Investigations were conducted on Nolin Reservoir tailwater and Barren Reservoir tailwater to evaluate success in controlling tailwater temperatures through the utilization of multi-level releases, and to determine the fish population composition, and to measure fishing intensity, creel composition and fishing success on the tailwater. Gate-level releases were required during the temperature control period to control reservoir water levels and this contributed to lower tailwater temperatures during the months of April, May, June, and July. Electrofishing studies revealed that substantial numbers of

fishes emigrated from the reservoir into the tailwaters. Species dominance in the sections immediately below the dams fluctuated with the reservoir regulation period. During the seasonal pool period in the summer, game fishes and panfishes were most abundant; after drawdown in the fall threadfin shad was the dominant species; and prior to the seasonal pool period in early spring carp was the dominant species. The catch rate fluctuated from a low of 0.33 fish per hour at Barren to a high of 1.47 fish per hour at Nolin. The estimated annual harvest ranged from 3,486 fishes at Nolin to 15,852 fishes at Barren. At Nolin the creel was numerically dominated by crappies the third year of impoundment and sunfishes the fourth year. At Barren the creel was numerically dominated by suckers, carp, and crappies, respectively, during the first three years of impoundment. (Novotny-Vanderbilt)
W70-04478

NATURAL PROCESSES AND THEIR INFLUENCE ON RESERVOIR WATER QUALITY,
Wisconsin Univ., Madison. Dept. of Civil Engineering.
S. G. Walesh.
Journal American Water Works Association, Vol. 59, No. 1, p. 63-79, January 1967. 1 fig., 2 tab., 22 ref.

Descriptors: *Reservoir, *Thermal stratification, Water quality, Temperature, Dissolved oxygen, *Iron, *Manganese, Hypolimnion, Silica, Diatoms, Alkalinity, Oxygen, Water chemistry, Water quality control.
Identifiers: Lock Raven Reservoir, Gunpowder Falls River, Prettyboy Reservoir, Specific conductance.

A study was made to provide a representative description of the physical, chemical, and biological aspects of Loch Raven Reservoir, and to illustrate how natural phenomena may affect the quality of water in and from water supply impoundments. Results and discussions are presented on temperature, dissolved oxygen, silica, diatoms, iron, manganese, specific conductance, and alkalinity in the reservoir. The conclusions are that the effects of thermal stratification, hypolimnetic dissolved oxygen depletion, etc., are the result of processes in the sediment. The two most significant substances with nuisance potential which went into solution when hypolimnetic oxygen depletion occurred were iron and manganese. Draft gate operation can be a critical factor in determining the quality of water received from the reservoir. (Rietveld-Vanderbilt)
W70-04479

MATHEMATICAL SIMULATION OF THERMAL STRATIFICATION IN DEEP IMPOUNDMENTS,
Water Resources Engineers, Inc., Walnut Creek, Calif.
G. T. Orlob, and L. G. Selna.
Proceedings, ASCE Specialty Conf. on Current Research into the Effects of Reservoirs on Water Quality, Jan. 1968, Technical Report No. 17 in Environmental and Water Resources Engineering, Vanderbilt University, Nashville, Tenn, 33 p. 10 fig., 20 ref.

Descriptors: *Mathematical models, *Temperature, *Impoundments, Lakes, Reservoirs, Epilimnion, Hypolimnion, Thermocline, *Thermal stratification, Diffusion, Mixing, Heat balance, Energy transfer, Digital computers, Heat transfer, Temperature gradient, Thermal properties, Thermal conductivity, Inflow.

A theory and practical experience with mathematical modeling of the thermal behavior of water in reservoirs and lakes is presented in the paper. As to diffusion processes occurring in heat mixing, it was stated that (1) Effective mixing in the epilimnion is greatest near the surface but declines rapidly with depth as the thermocline is approached. (2) The effective diffusion coefficient is minimal at or very near the position of the thermocline. (3) In the hypolimnion the effective diffusion coefficient increases with depth in a erratic manner, reaching a maximum roughly equivalent to that of the epilimnion at about mid-depth, thereafter decreasing as the bottom is approached. Model was verified using the real data and conclusions are the following: (1) The transfer of energy into deep stratified impoundments is accomplished by advection, direct solar insolation, convective mixing associated with cooling at the surface, and effective diffusion. (2) The transfer of energy from the epilimnion to the hypolimnion by diffusion is limited at the thermocline. (3) A one-dimensional mathematical representation of energy transfer processes is satisfactory for deep reservoirs. (4) Reservoir thermal behavior over annual or diurnal cycles can be simulated with a mathematical model using as input information continuous records of hydrologic, meteorologic, and climatologic conditions of the system. (Novotny-Vanderbilt)
W70-04481

DEVELOPMENT OF A MATHEMATICAL MODEL FOR PREDICTION OF TEMPERATURE IN DEEP RESERVOIRS PHASE I: LOW DISCHARGE VOLUME RATIO RESERVOIRS,
Water Resources Engineers, Inc., Lafayette, Calif.
For primary bibliographic entry see Field 06A.
W70-04483

IMPOUNDMENT DESTRATIFICATION FOR RAW WATER QUALITY CONTROL USING EITHER MECHANICAL OR DIFFUSED AIR PUMPING,
Federal Water Pollution Control Administration, Cincinnati, Ohio.
For primary bibliographic entry see Field 05F.
W70-04484

FIELD EXPERIMENTS ON THE EFFECT OF LIGHT CONDITIONS IN PHRAGMITES STANDS ON THE PRODUCTION OF LITTORAL ALGAE,
Warsaw Univ. (Poland). Dept. of Hydrobiology; and Ceskoslovenska Akademie Ved, Prague. Hydrobiological Station.
E. Pieczynska, and M. Straskraba.
Bulletin de l'Academie Polonaise des Sciences (Serie des Sciences Biologiques), Vol 17, No 1, p 43-46, 1969. 2 fig, 4 ref.

Descriptors: *Radiation, *Analytical techniques, *Photosynthesis, *Algae, Plankton, Biomass, Littoral, Periphyton, Light intensity, Chlorophyll, Oxygen, Phosphorus, Nitrogen.
Identifiers: *Phragmites, Cladophora, Spirogyra, Smyslov Pond (Czechoslovakia), Southern Bohemia, Macrophytes.

Photosynthesis of planktonic and periphytic algae was determined in parts of Smyslov Pond, southern Bohemia, occupied by reeds, and in adjacent area free from macrophytes. Light and dark oxygen bottles with freshly collected Cladophora and Spirogyra spp, volumeter, Kjeldahl and Winkler methods served as analytical tools. Intensity of light and daily radiation were recorded by a photocell and a solarimeter. The chlorophyll content was also determined at four wavelengths by a spectrophotometer. The production of algae was considerably higher in open water than in portions of the pond shaded by reeds. The relationship under conditions of observation and on a per day basis was expressed by the equation: milligram oxygen/milligram nitrogen = 0.949 log gram caloric/square centimeter - 1.208. (Wilde-Wisconsin)
W70-04491

TREATMENT OF ALGAE AND WEEDS IN LAKES AT MADISON,
Health Dept., Madison, Wis. Lab.
Bernard P. Domogalla.
Engineering News-Record, Vol 97, No 24, p 950-954, 1926. 8 fig, 3 tab.

Descriptors: *Copper sulfate, *Eutrophication, *Algae, *Aquatic weeds, Lakes, Algicides, Aquatic weed control, Mechanical control, Water pollution control, Chemcontrol, Arsenic compounds, Nitrogen, Phosphorus.
Identifiers: *Madison lakes (Wis), *Aquatic weed cutting, *Weed extracting steel cables, Algal succession, Anabaena, Cladophora, Pediastrum, Hydrodictyon, Potamogeton, Ranunculus.

Field and laboratory investigations of highly eutrophic lakes in the vicinity of Madison yielded several conclusions. The copper sulfate dragging method proved to be most effective for suppression of bottom-anchored algae on wind exposed areas. The surface algae and those inhabiting shallow waters were best controlled by spraying with copper sulfate. Weeds in open water were eliminated by weed-cutting machines. Stems and roots of weeds in shallow waters and near shore lines were extracted by steel cables with clips and swivels. Several species of water weeds were eradicated by sodium arsenite. The study disclosed a seasonal succession of aquatic plants and a pronounced relationship between eradication treatments and biological fixation of available forms of nitrogen and phosphorus. (Wilde-Wisconsin)
W70-04494

THE BOTTOM FAUNA OF LAKE VATTERN, CENTRAL SWEDEN, AND SOME EFFECTS OF EUTROPHICATION,
Ulf Grimas.
Institute Freshwater Research Reports, Drottningholm, Sweden, Vol 49, p 49-62, 1969. 3 fig, 3 tab, 18 ref.

Descriptors: *Lakes, *Benthic fauna, *Eutrophication, *Biomass, Productivity, Phosphorus, Nitrogen, Organic matter, Water pollution effects.
Identifiers: *Lake Vattern (Sweden), Sweden, Oligotrophic lakes, Pontoporeia affinis.

Lake Vattern, a large oligotrophic lake, is being subjected to inputs of phosphorus and nitrogen (resulting from human activities) at rates of 200 and 400 metric tons/year, respectively. Phosphorus input has increased approximately 300% during the last 50 years. Input of nitrogen from all sources, including precipitation, is about 1900 metric tons/year; organic matter, excluding industry and communities, is estimated at 50,000 metric tons/year. Biomass of benthic organisms ranges from 0.6 to 9.6 grams/square meter, dependent on depth and section of lake. Greatest numbers and biomass are found in depth ranges 0-20 meters (littoral) and 40-60 meters. Large crustaceans and oligochaetes dominate profundal (40-100 meter-depth) region; chironomids (Orthocladiinae, Tanytarsini, Chironomini) dominate littoral region. Highest average biomass (4-6 grams/square meter) is found in littoral region at southern end of the lake, where phosphorus and organic-matter input is greatest. Comparisons with data of 1911-1914 show increases in filtering animals (sphaeriids) and large crustaceans; these are considered indicative of an early phase of eutrophication. (Voigtlander-Wisconsin)
W70-04495

THE ECOLOGICAL DECLINE OF LAKE ERIE,
New York State Coll. of Agriculture, Ithaca.
Dean F. Arnold.
New York Fish and Game Journal, Vol 16, No 1, p 27-45, 1969. 5 fig, 69 ref.

Descriptors: *Lake Erie, *Eutrophication, *Water pollution effects, *Water pollution sources, Domestic wastes, Dissolved oxygen, Zooplankton, Benthic fauna, Fisheries, Walleye.
Identifiers: *Cultural eutrophication, Maumee River (Mich), Detroit River (Mich), Blue pike, Coregonids, Sturgeon.

Lake Erie is perhaps the best-documented example of a large lake which is deteriorating rapidly in several aspects, including eutrophy. The shallow Western Basin is exposed to high sediment loads, contributed largely by farmland erosion transported by the Maumee River. Human activities, including construction of jetties and erosion-control structures have increased total shore erosion and silt load. Effects of domestic and industrial pollution are most noticeable in the Western Basin. All chemical constituents except silicate and iron have increased from about 16 to 300% since 1906. Oxygen depletion is most notable in the deeper Central Basin. Average quantity of phytoplankton has increased threefold; shifts in species composition have been noted. Blue-green algae have become a dominant form; attached and floating algae have increased. Cladoceran zooplankton have increased as have characteristically eutrophic species of copepods. Mayfly naiads (Hexagenia) have decreased markedly while Oligochaetes, chironomid larvae and sewage fungus have increased. Populations of coregonids, sturgeon, pike (Stizostedion) have collapsed; shad, alewife, smelt, and carp have increased. Several feasible remedial actions have been proposed; their practicability and efficacy is difficult to predict. (Voigtlander-Wisconsin)
W70-04496

DISTRIBUTION OF C-14 IN PRODUCTS OF PHOTOSYNTHESIS AND ITS RELATIONSHIP TO PHYTOPLANKTON COMPOSITION AND RATE OF PHOTOSYNTHESIS,
Ashland Coll., Ohio. Dept. of Biological Sciences.
John H. Olive, Duane M. Benton, and Jack Kishler.
Ecology, Vol 50, No 3, p 380-386, 1969. 6 fig, 2 tab, 31 ref.

Descriptors: *Lakes, *Photosynthesis, *Phytoplankton, Methodology, Standing crop, Proteins, Carbohydrates, Lipids, Growth rates, Lake Erie.
Identifiers: *Carbon-14, *Photosynthetic rate, Cascinodiscus, Aphanizamenon, Microcystis, Ceratium.

Distribution of carbon-14 in four dominant species of phytoplankton was determined from in situ cultures. Ethanol-soluble fractions of phytoplankton accounted for 25-60% of assimilated carbon-14; insoluble fractions accounted for 20-48%. Ion-exchange fractionation of ethanol-soluble fraction revealed 68-83% of carbon-14 in carbohydrate-lipid fraction; 8-23% in non-amino organic acid fraction and 3-20% in free amino acid fraction. Distribution of carbon-14 in different fractions varied with species of alga, rate of population increase and level of illumination. Rapidly-growing populations showed higher proportions of carbon-14 in protein fractions; high proportions of carbon-14 in carbohydrate-lipid fractions were associated with high photosynthetic rates. Graphical data include temporal variation in distribution of carbon-14 and in total and relative rates of photosynthesis. (Voigtlander-Wisconsin)
W70-04497

THE LIMNOLOGY AND PRODUCTIVITY OF THREE CALIFORNIA COLDWATER RESERVOIRS,
California State Dept. of Fish and Game, Sacramento. Inland Fisheries Branch.
Stephen J. Nicola, and David P. Borgeson.
California Fish and Game, Vol 56, No 1, p 4-20, 1970. 8 fig, 3 tab, 20 ref.

Descriptors: *Limnology, *Productivity, *Fish, *Reservoirs, Zooplankton, Rainbow trout, Primary productivity, Secondary productivity, Daphnia, Copepods, Dissolved oxygen, Brown trout, Trophic level, California, Food habits, Food chains.
Identifiers: *Sierra Nevada reservoirs, Lake Spaulding (Calif), Beardsley Reservoir (Calif), Icehouse Reservoir (Calif), Bosmina, Holopedium, Kokanee.

Three reservoirs on the western slope of the Sierra Nevadas yielded estimates of mean daily net primary productivity from 119 to 314 milligrams carbon/square meter (June through October). Mean standing crops of zooplankton ranged from 562 to 951 milligrams/square meter dry weight; mean annual yield of game fish ranged from 0.75 to 6.71 kilograms/hectare wet weight. Primary productivity appeared to be directly related to temperature and inversely related to flushing rate of the reservoirs. Rotifers were most numerous zooplankter but did not contribute significantly to total weight. Dominant zooplankton for Beardsley, Icehouse, and Spaulding Reservoirs were, respectively, (1) Daphnia and calanoid copepods, (2) cyclopoid copepods, and (3) Bosmina coregoni. Fisheries consisted of rainbow and brown trout in all three lakes and included kokanee in Icehouse. Game fish yield in Spaulding and Beardsley varied from 0.69 to 0.87 and 2.99 and 9.84 kilogram/hectare, respectively. Kokanee assumed a dominant role in the Icehouse fishery two years after introduction. Zooplankton dominated fish diets in Beardsley, aquatic invertebrates and terrestrial organisms dominated diets in Spaulding. Comparison of productivity indices suggest all three fisheries are under-utilized. (Voigtlander-Wisconsin)
W70-04498

BIOLOGY OF THE CRAYFISH ORCONECTES CAUSEYI AND ITS USE FOR CONTROL OF AQUATIC WEEDS IN TROUT LAKES,
Bureau of Sport Fisheries and Wildlife, Washington, D.C.
Jack L. Dean.
Bureau of Sport Fisheries and Wildlife, Technical Paper, No 24, 1969. 15 p. 8 fig, 3 tab, 14 ref.

Descriptors: *Crayfish, *Aquatic weeds, *Aquatic weed control, Ecology, Life history studies, Fecundity, Fish management.
Identifiers: *Trout lakes, Potamogeton, Myriophyllum, Ranunculus, Chara, Ceratophyllum, Elodea.

Control of submerged aquatic plants has been achieved in shallow lakes of the Southwest by introduction of the crayfish Orconectes causeyi. Crayfish growth is rapid during summer (June through late September). Both sexes attain maturity at 14 to 15 months; maximum ages of both sexes is about 37 months. Females produce high numbers of ovarian eggs (mean of 62 females was 588, maximum number was 1237); reduction to number of pleopod eggs was estimated to be 29%. O causeyi is a tertiary burrower, utilizing a variety of substrate types. It is primarily vegetarian (diet consisted of 51% algae, 27% vascular plant material, 18% detritus, and 4% animal food); cannibalism will occur under conditions of food scarcity. Weed control was proportional to crayfish population and proximity to a rocky substrate. Field and laboratory tests showed control or utilization of Potamogeton spp, Ceratophyllum, Ranunculus, Elodea, Myriophyllum, Chara, Najas, Cabomba, and Vallisneria. Crayfish did not control Polygonum, Scirpus, or Typha. Control includes habit of cutting vegetation at the substrate and uprooting vegetation. Comparison of life history data with those of O virilis suggests that the latter species may be an effective weed-control agent in the upper Midwest. (Voigtlander-Wisconsin)
W70-04500

2I. Water in Plants

AN EXPERIMENTAL STUDY OF THE UPTAKE OF WATER BY SOYBEAN ROOTS,
Illinois Univ., Urbana. Dept. of Agronomy.
For primary bibliographic entry see Field 02D.
W70-04069

SAGEBRUSH CONVERSION TO GRASSLAND AS AFFECTED BY PRECIPITATION, SOIL, AND CULTURAL PRACTICES,
Geological Survey, Denver, Colo. Water Resources Div.
For primary bibliographic entry see Field 03B.
W70-04322

EFFECTS OF IRRIGATION REGIMES ON GRAPEFRUIT PEEL AND PULP RELATIONSHIPS,
National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research.
A. Cohen, A. Goell, A. Rassis, and M. Gokkes.
Israel Journal of Agricultural Research, Vol 18, No 4, p 155-160, October 1968. 4 tab, 7 ref.

Descriptors: *Grapefruit, *Irrigation effects, *Crop response, *Irrigation practices, *Rates of application, Citrus fruits.
Identifiers: *Israel, *Peel/pulp ratio.

A higher peel/pulp ratio occured in grapefruit from trees receiving limited irrigation than was found in trees that were frequently and amply irrigated. Irrigation effects were most strongly marked during the rainless summer period, when the drier regimes inhibited peel growth relatively more than pulp growth. However, even though the peel grew less than the pulp, it concerned a smaller fraction of total growth and the final figures showed that the drier regimes yielded fruit with a higher peel/pulp ratio. (Carr-Arizona)
W70-04403

ROW SPACING AND FERTILIZATION INFLUENCES ON FORAGE AND SEED YIELDS OF INTERMEDIATE WHEATGRASS, RUSSIAN WILDRYE, AND GREEN NEEDLEGRASS ON DRYLAND,
Agricultural Research Service, Sidney, Mont. Northern Plains Soil and Water Research Center; and Montana Agricultural Experiment Station, Bozeman.
A. L. Black, and L. L. Reitz.
Agronomy Journal, Vol 61, No 5, p 801-805, September-October 1969. 2 fig, 3 tab, 14 ref.

Descriptors: *Great Plains, *Fertilization, *Forage grasses, *Seeds, *Crop response, Phosphorous, Nitrogen compounds, Water utilization, Crop production, Semiarid climates.
Identifiers: *Row spacing, Seed yield.

The purpose of this five-year study was to determine the effects of row spacing and fertilization on forage and seed production of intermediate wheatgrass, Russian wildrye, and green needlegrass. These three grasses are commonly grown on the dry northern Great Plains and intensive soil management was practiced in order to study their maximum water-use efficiencies. The grasses differed in their response (forage, seed production, water use, and nitrogen and phosphorous recovery) to spacing and fertilizing combinations. Green needlegrass was particularly noticeable for its low water-use efficiency in comparison to the other grasses. It is concluded that the optimum row spacing is 107, 76, and 76 cm respectively for intermediate wheatgrass, Russian wildrye, and green needlegrass. 40 to 60 kg/ha of nitrogen with phosphorous added should be applied annually. (Carr-Arizona)
W70-04406

MOISTURE CONTENT OF COTTON LEAVES AND PETIOLES AS RELATED TO ENVIRONMENTAL MOISTURE STRESS,
Texas A and M Univ., College Station; and Texas Agricultural Experiment Station, El Paso.
D. E. Longenecker, and P. J. Lyerly.
Agronomy Journal, Vol 61, No 5, p 687-690, September-October, 1969. 3 fig, 16 ref.

Descriptors: *Moisture stress, *Soil moisture, *Cotton, *Leaves, *Soil-water-plant relationships, Irrigation, Timing, Irrigation efficiency, Moisture deficit, Arid lands, Soil types, Plant physiology, Wilting point.
Identifiers: *Petioles.

The purpose of the study was to determine the change over a period of time of leaf and petiole moisture content in cotton. The study interval began following irrigation and continued until permanent wilting developed. In both field and greenhouse conditions, there was a gradual decrease in leaf and petiole moisture percentage as soil moisture was depleted. Throughout this period the petioles showed the more uniform depletion curves and higher moisture percentages. This would indicate that petioles are more useful and dependable in registering changes in soil-water-plant relationships. Before this information could be used to predict when to irrigate, it appears it would be necessary to calibrate data for different soil types. (Carr-Arizona)
W70-04407

AN ECOLOGICAL SIGNIFICANCE OF SEASONAL LEAF VARIABILITY IN A DESERT SHRUB,
California Univ., Riverside. Dept. of Life Sciences.
G. L. Cunningham, and B. R. Strain.
Ecology, Vol 50, No 3, p 400-408, Late Spring 1969. 7 fig, 3 tab, 18 ref.

Descriptors: *Desert plants, *Variability, *Plant morphology, *Leaves, *Photosynthesis, Arid lands, Structure, Carbon dioxide, Resistance, Water vapor, Diffusion, Biorythms, Soil water, Seasonal, Precipitation (Atmospheric), On-site tests.
Identifiers: *Brittlebush, *Sonoran Desert, *Moisture status, Leaf structure.

The study was designed to find out to what extent seasonal leaf variability increases the survival capability of Encelia farinosa. This particular plant species was selected for observation because it is a perennial showing great seasonal variation in leaf structure and quantity. Field records established that leaf quantity and structure are controlled by environmental moisture status. Field observations also demonstrated the influence of leaf quantity and structure on CO sub 2 exchange capacity and water status of the shrub. These findings were corroborated by laboratory investigations, which also indicated that influence of leaf structure is due to alteration in the resistances to CO sub 2 and water vapor diffusion. The conclusion is that seasonal leaf variability provides Encelia farinosa with an increased ability to accumulate photosynthate in a desert environment. (Carr-Arizona)
W70-04414

EFFECTS OF WATER POTENTIAL ON GERMINATION OF LETTUCE, SUNFLOWER, AND CITRUS SEEDS,
California Univ., Riverside, Dept. of Horticultural Science.
Merrill R. Kaufmann.
Canadian Journal of Botany, Vol 47, No 11, p 1761-1764, November 1969. 3 fig, 1 tab, 6 ref.

Descriptors: *Moisture stress, *Seeds, *Germination, *Lettuce, *Citrus fruits, Arid lands, Semiarid climates, Solutes, Moisture availability.
Identifiers: *Water potential, *Sunflowers.

In arid and semiarid climates there may be a critical shortage of water at the time of seed germination. The study deals with the effect of controlled water potential or germination of citrus, sunflower, and lettuce seeds. The method for achieving nearly constant water potential without solute effect is based on the principles of Painter, Cox, and Boersma. For all three species tested the most rapid emergence occurred at 0 bars. Sunflowers germinated at water potentials as low as -8.0 bars, citrus at -4.7 bars, and lettuce at-4.1 bars. Citrus germinated most slowly, requiring 26 days at 0 bars to achieve 50% germination. Sunflowers reached 50% germination in 8 days at-4.1 bars, but lettuce required -2.3 bars before it could germinate at the same rate. (Carr - Arizona)
W70-04416

AN UNUSUAL PHOTONASTISM INDUCED BY DROUGHT IN PHASEOLUS VULGARIS,
Department of Agriculture, Lethbridge (Alberta). Research Station.
S. Dubetz.
Canadian Journal of Botany, Vol 47, No 10, p 1640-1641, October 1969. 2 fig, 9 ref.

Descriptors: *Beans, *Drought, *Moisture stress, *Crop response, *Plant physiology, *Phototropism, Water utilization, Turgidity, Thermal stress, Transpiration, Soil-water-plant relationships, Leaves, Solar radiation, Thermal capacity.
Identifiers: *Photonastism, Canada.

In an outdoor experiment Phaseolus vulgaris was subjected to moisture stress. 30 to 40 days after emergence some of the plants were placed under soil water stress of 8 bars. On hot, sunny days the stressed plants exhibited the photonastic phenomenon. Photonasty is considered a special case of phototropism in which the light response of mature plant tissue consists of turgor changes. Under conditions of extreme drought and intense sunlight the leaves of P. vulgaris orient themselves parallel to the incident light. In this position they will follow the course of the sun. This leaf orientation and movement apparently are adaptations to minimize transpiration and prevent thermal death. (Carr - Arizona)
W70-04417

EFFECT OF MOISTURE STRESS ON THE ABSORPTION AND TRANSPORT OF HERBICIDES IN WOODY PLANTS,
Agricultural Research Service. Crops Research Division; and Texas A and M Univ. Dept. of Range Science.
F. S. Davis, M. G. Merkle, and R. W. Bovey.
Botanical Gazette, Vol 129, No 3, p 183-189, September 1968. 5 fig, 4 tab, 14 ref.

Descriptors: *Herbicides, *2-4-5-T, *Absorbtion, *Moisture stress, *Mesquite, Chaparral, Brush control, Range management, Defoliants, Plant physiology, Arid lands, Semiarid climates, leaves, Analytical techniques, Vascular tissues, Turgidity.
Identifiers: *Picloram, *Winged elm.

Mesquite and winged elm were studied in a controlled environment to determine the effect of moisture stress on the absorption and distribution of 2,4,5-T and picloram. Moisture stress did not effect absorption of 2,4,5-T, but did reduce uptake of picloram in mesquite. Stress also reduced transport of the herbicides in both species, with reduction generally paralleling retarded growth. The greatest reduction in transport occurred either at moderate stresses or when extensive movement occurred under no stress. (Carr - Arizona)
W70-04418

2J. Erosion and Sedimentation

SOIL MOVEMENT IN AN ALPINE AREA,
Colorado State Univ., Fort Collins. Natural Resources Center.
W. D. Striffler.
Available from the Clearinghouse as PB-189 785, $3.00 in paper copy, $0.65 in microfiche. Colorado State Univ, Natural Resources Center, Partial Completion Report, June 30, 1969. 4 p, 3 ref. OWRR Project A-002-COLO.

Descriptors: *Soil erosion, *Alpine soil, *Tundra erosion, Sediment transport, Soil movement.

Erosion transects were established at two alpine sites in Colorado. Site variables included two aspects (north and south), two slope positions (upper and lower), and three slope classes ranging from five to sixty percent. Soil particle tagging with flourescent dye permitted soil migration to be observed. Small micro-plots were fitted with soil collectors to catch migrating soil particles for laboratory analysis. Maximum soil particle displacement on undisturbed steep mountain slopes averaged less than one meter over a two-year period. Particle movement is highly correlated with no deposition. Particle movement is also correlated with slope, position on slope, litter cover, rock cover, and infiltration rate. Surface soil particle, sprayed with flourescein dye remain sufficiently visible for observation over a two-year period.
W70-04059

HYDRAULIC RESISTANCE IN ALLUVIAL CHANNELS,
Illinois Univ., Urbana. Dept. of Civil Engineering.
Ben Chie Yen, and Ying-Chang Liou.
Available from the Clearinghouse as PB-189 789, $3.00 in paper copy, $0.65 in microfiche. Completion Report, Illinois Water Resources Center, Research Report No 22, July 1969. 66 p, 24 tab, 5 fig, 51 ref, 1 append. OWRR Project A-033-ILL.

Descriptors: *Alluvial channels, Dimensional analysis, *Flow resistance, Hydraulics, Open-channel flow.
Identifiers: *Sediment.

An analytical study was conducted for the determination of the Weisbach resistance coefficient for flow in sand-bed straight channels. Available experimental data were reanalyzed based on dimensional analysis and fluid mechanics concepts. It was found that for flows having width to depth ratio greater than 5, there is a unique and systematic relationship among the Weisbach resistance coefficient f, and Froude number of the flow, and the sediment particle size to hydraulic radius ratio. The bed form which also is a dependent variable is also uniquely determined. For flow with Froude number less than 0.5 where its effect can be neglected, the resistance coefficient can be expressed as a function of the Reynolds number, sediment size to hydraulic radius ratio, and the sediment terminal fall velocity to shear velocity ratio. Application of the results for engineering purposes is also discussed. The technique for engineering applications of the results appear to be quite simple.
W70-04070

COMPOSITION OF INTERSTITIAL WATERS OF MARINE SEDIMENTS: TEMPERATURE OF SQUEEZING EFFECT,
Southern California Univ., Los Angeles.
For primary bibliographic entry see Field 02K.
W70-04075

FUNCTIONAL RELATIONSHIPS BETWEEN DENUDATION, RELIEF, AND UPLIFT IN LARGE MID-LATITUDE DRAINAGE BASINS,
Maryland Univ., College Park. Dept. of Geography.
Frank Ahnert.
American Journal of Science, Vol 268, No 3, p 243-263, Mar 1970. 21 p, 7 fig, 2 tab, 21 ref.

Descriptors: *Erosion, *Topography, *Geomorphology, Geology, Precipitation (Atmospheric), Drainage density, Drainage patterns (Geologic), Land forming, Structural geology.
Identifiers: Geological uplift.

The mean denudation rate in mid-latitude river basins is directly proportional to mean basin relief. Mean annual precipitation has no noticeable effect upon the denudation rate. Without any uplift, the relief is reduced to 10% of its initial value in 11 million years; with isostatic compensation, this time increases to at least 18.5 million years. Establishment of a steady state relief would require a constant rate of uplift for more than 20 million years and thus is unlikely to occur. Oscillating rates of uplift cause corresponding oscillations of relief. The quantitative relationship between uplift, relief, and denudation may permit order-of-magnitude estimates of current rates of uplift. (Knapp-USGS)
W70-04076

THE NATURE OF KARSTIC PROCESSES IN THE PERMIAN HALOGEN SEDIMENTS OF THE DONETS BASIN USING THE BAKHMUT BASIN AS AN EXAMPLE (RUSSIAN),
N. S. Podorvanov, and Ye. A. Savichenko.
In: Trudy Soveshchaniya po Voprosam Kompleksnogo Izucheniya Rezhima Poverkhnostnykh i Podzemnykh Vod v Karstovykh Rayonakh (Proc of Conf on Complex Problems of Surface and Groundwater Systems in Karstic Regions), Upravleniye Gidrometeorologicheskoy Sluzhby, Ukr, SSR, p 80-83, 1969. 4 p.

Descriptors: *Karst, *Erosion, *Sediments, Geology, Clays, Limestones, Sands, Gypsum, Salts, Groundwater, Boreholes, Mining, Leaching, Groundwater movement.
Identifiers: Donets basin, USSR.

The geology of the Permian rocks in the Bakhmut basin and the development of the basin's karstic features are described. The karstic processes of the basin take place in the halogen-carrying formations of Lower Permian age located at relatively shallow depth. Leaching of these halogen formations is due to the circulation surface and underground waters and takes place down to depths of 40 to 250 m. (Gabriel-USGS)
W70-04105

KARST AND ASSOCIATED UNDERGROUND WATERS OF THE SOUTHWESTERN PART OF THE DONETS BASIN (RUSSIAN),
Akademiya Nauk URSR, Kiev. Instytut Geologichnykh Nauk.
For primary bibliographic entry see Field 02F.
W70-04106

KARST FORMATION AT THE ARTEMOVSK OCCURRENCE OF ROCK SALT (RUSSIAN),
I. M. Aleksandrov.
In: Trudy Soveshchaniya po Voprosam Kompleksnogo Izucheniya Rezhima Poverkhnostnyky i Podzemnykh Vod v Karstovykh Rayonakh (Proc of Conf on Complex Problems of Surface and Groundwater Systems in Karstic Regions), Upravleniye Gidrometeorologicheskoy Sluzhby, Ukr, SSR, p 73-79, 1969. 7 p, 1 fig, 1 tab.

Descriptors: *Karst, *Aquifers, *Groundwater, *Mineral industry, *Salts, Discharge (Water), Mine drainage, Mine water, Mining engineering, Water chemistry, Sulfates, Deterioration, Geology, Sandstones, Runoff, Surface runoff, Water circulation, Boreholes, Corrosion.
Identifiers: *USSR, Artemovsk mines.

The formation of karstic features in the rock salt horizon of the Artemovsk rock-salt mine is described. The discharge values of water in shafts and tunnels of the mine, the geology of water-bearing horizons and streams, and the damage done to the concrete used in the mine are also discussed. (Gabriel-USGS)
W70-04107

A DEVICE FOR DETERMINING SEDIMENTATION RATES IN RESERVOIRS,
Bureau of Sport Fisheries and Wildlife, Yankton, S. Dak. North Central Reservoir Investigations.
Bruce C. Cowell, and Patrick L. Hudson.
Limnology and Oceanography, Vol 13, No 1, p 196-198, 1968. 2 fig.

Descriptors: *Sedimentation rates, *Reservoirs, Deposition (Sediments), Cores, Sampling, Currents (Water), Velocity, SCUBA diving.
Identifiers: *Sediment trap, Gross sedimentation rates, Sediment composition.

A more rapid determination of sedimentation rates and sediment composition in reservoirs than core sampling and not subject to errors associated with open containers can be effected with the apparatus described. It can be stabilized at desired depths so that flocculent bottom materials are not collected, and it can be closed before retrieval. The data obtained with this device are more closely representative of the gross sedimentation rate than the net rate that actually prevails, and thus determinations of energy flux tend to be artificially high. For this reason, the apparatus is used only to provide comparative data between stations within a reservoir or between reservoirs in the same river system. In operation, this sediment trap, is slowly lowered to the bottom with an anchor and messenger cable. Bottom materials are disturbed by the anchor as little as possible. After 24-48 hours a messenger is dropped and the sediment trap retrieved. The operation was observed with SCUBA equipment and current was found the major factor limiting use. The device could be modified for use in currents so that it would remain vertical, regardless of apparatus tilt. (Jones-Wisconsin)
W70-04191

NEW METHODS OF PROBABILITY CALCULATIONS FOR DISCHARGES AND NON-SCOURING VELOCITIES IN RIVERS' CROSS-SECTIONS,
Institute of Building Technics, Warsaw (Poland).
Walenty Jarocki.
Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 73, p 589-594, 1967. 6 p, 3 tab, 2 ref.

Descriptors: *Erosion, *Scour, *Probability, *Statistical methods, *Streamflow forecasting, Discharge (Water), Stage-discharge relations, Channel morphology.
Identifiers: Scour prediction.

New methods of calculation of probabilities of discharges as well as sediment balance for the calculation of scour near hydraulic structures are presented. The methods are based on the assumption that the discharges of various probability should be calculated taking into account the maximum discharge which can occur in the given basin. According to the principle of conservation of energy the river bed will not scour if the quantity of sediment is the same downstream and upstream of the considered contract river cross-section. (Knapp-USGS)
W70-04255

ROLE OF SALT WEDGE IN BAR-FINGER SAND AND DELTA DEVELOPMENT,
Northeastern Illinois State Coll., Chicago. Dept. of Geology.
George T. Moore.
The American Association of Petroleum Geologists Bulletin, Vol 54, No 2, p 326-333, Feb 1970. 8 p, 6 fig, 4 tab, 10 ref.

Descriptors: *Deposition (Sediments), *Sediment transport, *Saline water intrusion, *Mississippi River, *Deltas, Sedimentation, Sedimentary structures, Sand bars, Coasts.
Identifiers: Bar-finger sands.

Linear, continuous deposits, composed primarily of fine and very fine sand, which occupy the channels and distributaries of the lower Mississippi River are termed 'bar-finger sands.' These deposits originate as distributary-mouth bars but their development continues after the river has prograded beyond the original site of bar formation. The intrusion of salt water into the river channel during periods of low discharge reduces the current directly above the bed and causes deposition of the coarser fractions of sand along the channel. Because this phenomenon occurs during much of the year, a net buildup of sediment occurs. (Knapp-USGS)
W70-04306

EFFECT OF CONCENTRATION ON SEDIMENT DISTRIBUTION,
Missouri Univ., Columbia. Dept. of Civil Engineering.
A. T. Hjelmfelt, and C. W. Lenau.
ASCE Proceedings, Journal Hydraulics Division, Vol 95, No HY5, p 1775-1779, Sept 1969. 5 p, 2 fig, 3 ref. OWRR Project No A-015-MO

Descriptors: *Sedimentation, *Suspended load, *Settling velocity, Deposition (Sediments), Mathematical studies, Particle size, Sediment load, Stokes law, Suspension.
Identifiers: Sediment concentration.

The effects of sediment concentration on the fall velocity of suspended material are studied analytically. The results are shown by graphs. (Knapp-USGS)
W70-04320

THE RELATION OF TURBULENCE TO DEPOSITION OF MAGNETITE OVER RIPPLES,
Geological Survey, Fort Collins, Colo.
Raul S. McQuivey, and Thomas N. Keefer
Available from Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $3.75. Geological Survey Research 1969, Professional Paper 650-D, p D244-D247, 1969. 4 p, 3 fig, 2 ref.

Descriptors: *Deposition (Sediments), *Sediment transport, *Turbulence, *Ripple marks, *Hydraulic models, Settling velocity, Density, Separation techniques, Sedimentary structures, Turbulent flow, Erosion, Scour.
Identifiers: Heavy minerals, Magnetite, Sorting.

Sorting of magnetite and other heavy minerals from predominantly quartz bed material occurs because of variations in turbulent shear stress from trough to crest of ripples and because for particles less than one-tenth millimeter in diameter critical shear stress is a function of density only. The sorted particles of heavy minerals tend to accumulate just upstream of ripple crests. It is suggested that artificially generated turbulence could be employed to sort small-sized heavy-mineral particles from sediment flows. (Knapp-USGS
W70-04343

THE DEVELOPMENTAL HISTORY OF BLELHAM TARN (ENGLAND) AS SHOWN BY ANIMAL MICROFOSSILS, WITH SPECIAL REFERENCE TO THE CLADOCERA,
Indiana Univ., Bloomington. Dept. of Zoology.
For primary bibliographic entry see Field 02H.
W70-04459

AN ELECTRO-OPTICAL SYSTEM FOR MEASUREMENT OF MEAN AND STATISTICAL PROPERTIES OF SEDIMENT SUSPENSIONS,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
John R. Glover, P. K. Bhattacharya, and John F. Kennedy.
U S Army Corps of Engineers, Coastal Engineering Research Center, Washington, D C, Technical Report IIHR No 120, October 1969. 26 p. 15 fig.

Descriptors: *Erosion, *Sediment distribution, Sedimentation, Sediment-water interfaces, Instrumentation, Measurement, Beach erosion, Alluvial channels, Estuaries, Waves (Water), Shoals, Computers, Suspension.
Identifiers: *Suspended sediment, *Erosion transport, *Electro-optical measurement, Shoaling waves, Optical transducer, Multi-phase flow.

To achieve measurements of the mean, periodic, and random components of the concentration of suspended products or erosion, a new electro-optical system has been developed. The system includes a transducer of a gallium arsenide diode and a silicon planer diode as a light sensor. The intensity of light is modulated by the suspended material in the gap between the light source and sensor. The chassis is provided with signal analyzing circuitry, an analog- to-frequency converter, and multiplier circuits. The device measures suspension to 100 parts/million, computes the mean concentration,

the mean square of the fluctuation, and the correlation between the concentration and another signal supplied by the system. (Wilde-Wisconsin)
W70-04492

2K. Chemical Processes

SOLUTION GEOCHEMISTRY OF THE WATER OF LIMESTONE TERRAINS,
Kentucky Water Resources Inst., Lexington.
John Thrailkill.
Available from the Clearinghouse as PB-189 773, $3.00 in paper copy, $0.65 in microfiche. Research Report 19, Kentucky Water Resources Institute, Lexington, 1970. 125 p, 10 tab, 22 fig, 26 ref. OWRR Project A-009-KY.

Descriptors: Aquifers, Limestone, Vadose seepage, *Geochemistry, Calcite, Water quality, Analytical techniques, Kentucky, Calcium carbonate, Carbon dioxide, Carbonates, Karat.
Identifiers: *Limestone aquifer, *Groundwater.

Limestone groundwater flows mainly in openings it has solutionally enlarged, thus an understanding of the water's state of saturation relative to calcite (the principal mineral component of limestone) is fundamental to an understanding of the nature and evolution of the limestone aquifer. This study investigated the Mammoth Cave-Sinkhole Plain (MCSP) and Cave Hollow (CH) aquifers in Kentucky. Both aquifers were always undersaturated with calcite. Except for completely ventilated vadose flows and some vadose seepage, all recharges sampled were also undersaturated. The lack of saturation in the MCSP aquifer was due to the introduction of carbon dioxide into the water in amounts difficult to explain by the above recharges. In both vadose flows and seepage, undersaturation tended to correlate directly with flow volume, and there was an inverse correlation between the amount of carbon dioxide and calcite saturation in most of the waters sampled, suggesting seasonal invariance of carbon dioxide content of the water prior to outgassing. Results suggest solutional enlargement is greatest near recharge points in 'ventilated' aquifers (CH) but the carbon dioxide introduction phenomenon (MCSP) allows solution over wide areas in 'unventilated' aquifers.
W70-04061

COMPOSITION OF INTERSTITIAL WATERS OF MARINE SEDIMENTS: TEMPERATURE OF SQUEEZING EFFECT,
Southern California Univ., Los Angeles.
James L. Bischoff, Randall E. Greer, and Antonio O. Luistro.
Science, Vol 167, No 3922, p 1245-1246, Feb 1970. 2 p, 1 fig, 7 ref. NSF Grant GA 11490.

Descriptors: *Connate water, *Cores, *Test procedures, *Physicochemical properties, Sampling, Porous media, Water chemistry, Temperature, Sediments, Laboratory tests, Anion exchange, Potassium, Chlorides, Magnesium.
Identifiers: *Pore water chemistry, *Marine sediments, Interstitial waters.

To determine that potassium enrichments in interstitial water from marine sediments are due, in part, to temperature effects from sampling and squeezing, as recent studies indicated, a series of duplicate samples were tested using freshly collected core and then squeezing one set at in situ temperature and the other at laboratory temperature. Warming the samples to room temperatures prior to extraction of water from the sediments accounts for apparent enrichments of potassium ion (13.3%) and chloride ion (1.4%) and depletions of magnesium ion (2.5%) and calcium ion (4.9%). These differences result from changes in ion-exchange selectivity as a function of temperature. It is concluded that for accurate analyses of pore water chemistry, extraction of the pore water must be done at the in situ temperature of the sediment. (Lang-USGS)
W70-04075

SODIUM HAZARD OF BICARBONATE IRRIGATION WATERS,
California Univ., Riverside. Dept. of Soils and Plant Nutrition.
P. F. Pratt, and F. L. Bair.
Soil Science Society America Proceedings, Vol 33, No 6, p 880-883, Nov-Dec 1969. 4 p, 5 fig, 2 tab, 13 ref.

Descriptors: *Irrigation water, *Bicarbonates, *Sodium, Calcium carbonate, *Water chemistry, Acidity, Soils, Zeolites, Evapotranspiration, Water quality, Precipitation (Atmospheric), Lysimeters.
Identifiers: *Sodium hazard, Precipitation index.

Results of a 6-year lysimeter experiment show that the water quality value based on the precipitation index (PI) for calcium carbonate satisfactorily estimated the effect of the water on the composition of saturation extracts of soil samples, except where Na precipitation occurred. Essential conditions for Na precipitation, presumably as a zeolite, were a pH above 8.6 and time for dissolution of reactants from the soil and formation of the product. Tree trunk diameter growth by lemon trees (Citrus lemons) and evapotranspiration were linearly correlated with water quality values based on PI. (Carstea-USGS)
W70-04104

THE CURRENT TRITIUM CONTENTS OF NATURAL WATERS,
Akademiya Nauk SSSR, Moscow. Institut Geokhimii i Analiticheskoi Khimii.
A. P. Vinogradov, A. L. Devirts, and E. I. Dobkina.
Trans from Geokhimiya, No 10, p 1147-1162, 1968. Geochemistry International, Vol 5, No 5, p 952-966, 1968. 15 p, 4 fig, 5 tab, 50 ref.

Descriptors: *Tritium, *Surface waters, Fallout, Tracers, Water chemistry, Water quality, Hydrogen, Water analysis, Radiochemical analysis.
Identifiers: *USSR, Pakhva River, Oka River, Moscow.

Tritium analyses were made on a number of water and plant samples collected in the western USSR. The analyses were made by gas-proportional counting. The counters were steel or copper in conventional steel shields with a ring of geiger guard counters in anticoincidence with the main counter. The tritium content of atmospheric precipitation and water vapor near Moscow ranged from 400 to 800 TU in 1966 and from 40 to 300 TU in 1967. Lakes in the central and NW USSR ranged from 170 to 370 TU in 1967, while the Pakhva and Oka Rivers near Moscow in September 1967 had 65 and 34 TU, respectively. (Knapp-USGS)
W70-04116

NITROGEN-FIXING BLUE-GREEN ALGAE IN SWEDISH SOILS,
Uppsala Univ. (Sweden). Inst. of Physiological Botany.
Ulf Granhall, and Elisabet Henriksson.
Oikos, Vol 20, No 1, p 175-178, 1969. 3 tab, 15 ref.

Descriptors: *Nitrogen, *Nitrogen fixation, *Soil algae, Soils, Soil tests, Hydrogen ion concentration, Soil moisture.
Identifiers: *Blue-green algae, Acetylene reduction technique, Soil nitrogen, Heterocysts, Swedish soils, Nitrogen-fixing algae.

The relative abundance of nitrogen-fixing algae in different Swedish soils was studied in situ and in monocultures using the acetylene reduction technique. Sampling sites were distributed over entire Sweden and Gotland Island. Regardless of geographic location, soil properties exerted decisive influence on the presence and density of the organisms. Soils with reaction between pH 3 and pH 5 were free from blue-green algae; their occurrence was also greatly reduced by deficiency of moisture and low supply of nutrients. An abundant occurrence of nitrogen-fixing forms, including genera of Nostoc, Anabaena, Calothrix, and Tolypothrix, was confined to alkaline or slightly acid, moist soils which are low in combined nitrogen. The organisms are obviously of little importance to forest soils of the investigated region. (Wilde-Wisconsin)
W70-04186

A CRITICAL EVALUATION OF THE TROPHIC LEVEL CONCEPT. I. ECOLOGICAL EFFICIENCIES,
Wisconsin Univ., Madison. Dept. of Zoology.
Daniel G. Kozlovsky.
Ecology, Vol 49, No 1, p 48-60, 1968. 14 fig, 7 tab, 27 ref.

Descriptors: *Biomass, *Energy transfer, Trophic level, Efficiencies.
Identifiers: Energy retention, Bioactivity, Ecological efficiencies, Net community output, Eutrophic stage equilibrium.

A scheme of ecological efficiencies which equate terminology of various authors and the concepts of 'community efficiency' and 'community productivity' and proposes several new ways of calculating the net output taking into account all trophic levels or populations. The terms 'community efficiency of energy transfer' and 'community efficiency of energy retention' are suggested. (Wilde-Wisconsin)
W70-04251

0-18/0-16 RATIOS IN SNOW AND ICE OF THE HUBBARD AND KASKAWULSH GLACIERS,
Alberta Univ., Edmonton. Dept. of Geology; and Alberta Univ., Edmonton. Dept. of Physics.
D. S. Macpherson, and H. R. Krouse.
In: Isotope Techniques in the Hydrologic Cycle, Geophysical Monograph Series, No 11, American Geophysical Union, p 180-194, 1967. 15 p, 13 fig, 9 tab, 25 ref.

Descriptors: *Glaciers, *Ice, *Snow, Oxygen, Analytical techniques, Precipitation (Atmospheric), Snowmelt, Tracers.
Identifiers: *Hubbard Glacier, *Kaskawulsh Glacier, St. Elias Mountains.

One hundred samples collected from the Hubbard and Kaskawulsh glaciers in the St. Elias Mountains during the summer of 1963 were analyzed for 0-18 and 0-16. The delta 0-18/0-16 values ranged from -18 to -29 (SMOW), with an average of about -23. Pits that were studied before extensive melting showed definite trends, with the more negative values corresponding to winter precipitation. Pits studied later in the season had the seasonal trend masked by the action of downward percolating meltwaters. The average of all pits and boreholes studied above the firn line gave no indication of an altitude variation larger than the sampling error. A longitudinal profile below the firn line showed much scatter in the 0-18 value, but the average trend was a decrease in going down-glacier from the firn line to the terminus. A transverse profile below the firn line which sampled 3 main ice streams gave remarkably consistent values near the margins, whereas the stream centers had decidedly more positive or negative values. These results are considered in terms of accepted modes of glacier flow. Precipitation studies exhibited much scatter and did not show the expected altitude variation. Comparison of the over-all data with that of other workers shows a number of consistencies. This comparison also suggests that much of the precipitation in the area is derived from the Pacific Ocean rather than from inland sources. (Carstea-USGS)
W70-04260

U.S. GEOLOGICAL SURVEY WATER-QUALITY DATA IN THE WILLAMETTE BASIN, OREGON, 1910-64,
Geological Survey, Portland, Oreg.
R. J. Madison.
Geological Survey Basic-Data Release, Mar 1966. 40 p, 3 fig, 2 tab, index.

Descriptors: *Water quality, *Oregon, Water chemistry, Water analysis, Data collections, Hydrologic data, Streams, Rivers, River basins, Water pollution.
Identifiers: Willamette River basin (Ore).

This report presents chemical analyses of water samples collected in the Willamette Basin, Oreg., and analyzed by the U.S. Geological Survey. All data collected through September 1964 have been tabulated through the Survey's Automatic Data Processing system. These tabulations have been prepared to make the data available to all agencies working on the comprehensive study of the Willamette Basin. Because the Sandy River basin is a part of the study area, analyses of samples from that basin are also included. (Knapp-USGS)
W70-04261

CHANGES IN THE CLAY-WATER SYSTEM WITH DEPTH, TEMPERATURE, AND TIME,
Georgia Inst. of Tech., Atlanta. Water Resources Center.
C. E. Weaver, and Kevin C. Beck.
Available from the Clearinghouse as PB-189 168, $3.00 in paper copy, $0.65 in microfiche. Water Resources Center, Georgia Institute of Technology WRC-0769, Oct 1969. 95 p, 6 tab, 24 fig, 101 ref. OWRR Project A-008-GA

Descriptors: *Montmorillonite, *Illite, *Clay minerals, *Water chemistry, *Geochemistry, *Cations, Cation exchange, Cation adsorption, Anion exchange, Ion exchange, Ion transport, Hydrogen ion concentration, Pore pressure, Organic matter, Sodium, Potassium, Calcium, Manganese, Aluminum, Calcite.
Identifiers: *Interstitial water, *Interstitial ions.

An objective of the study was to determine the changes in the chemistry of the interstitial water of muds during burial. Side wall core samples of mud, ranging from 4,233 feet to 16,450 feet, were obtained from a well in the Mississippi Delta area. Analysis showed that the concentration of cations in the interstitial waters was approximately twice that of sea water. Na and K were more abundant and Ca and Mg less abundant than in sea water. K and Mg increase with depth. The anion concentration is HCO3 much greater than SO4 much greater than Cl. Cl is flushed from the system and systematically decreases with depth. SO4 is concentrated by filtering and HCO3 is created by the decomposition of organic matter and calcite. Na is the major exchange cation in the shallow samples and Ca in the deeper samples. Most of the exchangable Mg is gone at a depth of 4,233 feet. With depth montmorillonite layers alter to illite and chlorite layers even though the Al2O3/K2O and Al2O3/MgO ratios remain constant. There is some rearrangement of the elements in the solid phase but for complete conversion of montmorillonite to illite and chlorite, K and Mg must be added from below. (Conway-Georgia Tech)
W70-04295

ISOTOPIC COMPOSITION AND ORIGIN OF THE ATMOSPHERIC WATER VAPOR IN THE REGION OF LAKE LEMAN (IN FRENCH),
Pisa Univ. (Italy). Lab. of Nuclear Geology.
J.-Ch. Fontes, and R. Gonfiantini.
Earth and Planetary Science Letters, Vol 7, No 4, p 325-329, Jan 1970. 5 p, 1 fig, 3 tab, 9 ref.

Descriptors: *Evaporation, *Lakes, *Stable isotopes, *Tracking techniques, Water vapor, Mixing, Meteorology, Chemistry of precipitation, Distribution patterns, Humidity, Hydrologic cycle.
Identifiers: Lake Leman (Switzerland).

The isotopic composition of the atmospheric water vapor over Lake Leman changes regularly with the distance from the water surface. This fact indicates that the vapor results from a mixing of the vapor evaporated from the lake with the regional atmospheric vapor. The fractions of these two vapors of different origin are evaluated in each sample on the basis of the isotopic data. The method permits estimation of the climatic zone of influence of the lake in the atmosphere.
W70-04304

CHEMICAL AND RADIOCHEMICAL ANALYSES OF WATER FROM STREAMS, RESERVOIRS, WELLS, AND SPRINGS IN THE RULISON PROJECT AREA, GARFIELD AND MESA COUNTIES, COLORADO,
Geological Survey, Denver, Colo.
J. D. Larson, and W. A. Beetem.
Geological Survey Open-file Report, Jan 1970. 16 p, 2 fig, 6 tab, 6 ref. Contract No AT (29-2)-474 USAEC.

Descriptors: *Hydrologic data, *Colorado, *Water wells, *Streams, *Water quality, Data collections, Tritium, Water pollution sources, Nuclear explosions, Radiochemical analysis.
Identifiers: Project Rulison.

Wells were inventoried and sampled, and a network of 21 surface-water sampling stations was established in the Rulison area, Colorado, to determine changes in tritium content and water chemistry attributable to the Rulison project, an experiment in stimulating natural gas production by a nuclear explosion. Locations of the sampling sites, pre-explosion chemical analyses of surface waters and groundwaters, well records, cistern records, and spring records are tabulated. (Knapp-USGS)
W70-04307

RECENT DISSOLVED-OXYGEN MEASUREMENTS IN THE GULF OF MEXICO DEEP WATERS,
Office of Naval Research, Washington, D.C.; Texas A and M Univ., College Station. Dept. of Oceanography; and National Science Foundation, Washington, D.C.
Worth D. Nowlin, Jr., David F. Paskausky, and Hugh J. McLellan.
Journal of Marine Research, Vol 27, No 1, p 39-44, Jan 15, 1969. 6 p, 4 fig, 1 tab, 4 ref. ONR Contract Nonr 2119 (04).

Descriptors: *Dissolved oxygen, *Gulf of Mexico, Water chemistry, Water quality, Water temperature, Sea water.
Identifiers: Yucatan Basin.

Because in 1963 it was suggested that rather large gradients in dissolved oxygen exist in the Gulf of Mexico below a sill depth of between 1500 m and 1900 m, measurements were made on three cruises during 1966 and 1967. No clearly discernible horizontal variation in dissolved oxygen was found in these waters. Only slight vertical oxygen gradients were measured below the sill depth; the mean value obtained is approximately 5.0 ml/liter. The data obtained in 1966 and 1967 are compared with data obtained on 7 previous cruises in 1935, 1958, 1959, 1962, and 1964. (Knapp-USGS)
W70-04317

REDEFINITION OF SALINITY,
Scientific Committee on Oceanic Research (Gt. Brit.); International Council for the Exploration of the Seas; and International Association for the Physical Sciences of the Ocean.
For primary bibliographic entry see Field 07A.
W70-04318

DIFFERENCES IN SOIL CHEMISTRY INDUCED BY EVAPORATION AND FLOW OF GROUNDWATER,
Geological Survey, Denver, Colo.
For primary bibliographic entry see Field 02G.
W70-04340

DETERMINATION OF MERCURY IN NATURAL WATERS BY COLLECTION ON SILVER SCREENS,
Geological Survey, Denver, Colo.
Margaret E. Hinkle, and Robert E. Learned.
Available from Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $3.75 per copy Geological Survey Research 1969, Professional Paper 650-D, p D251-D254, 1969. 4 p, 6 tab, 12 ref.

Descriptors: *Water analysis, *Trace elements, *Geochemistry, Water chemistry, Separation techniques, Analytical techniques, Spectrophotometry.
Identifiers: Mercury analysis.

A method for determining nanogram quantities of mercury in natural waters is described wherein mercury is collected on silver screens immersed in samples acidified with hydrochloric acid and the collected mercury is measured by heating the screens in a mercury-vapor absorption detector. As little as 10 nanograms of Hg in 100 ml of water can be detected by this procedure. The speed and simplicity of this method permit its use in hydrogeochemical surveys where mercury is utilized as a pathfinder element. (Knapp-USGS)
W70-04341

EXTRACTION OF DISSOLVED CARBONATE SPECIES FROM NATURAL WATER FOR CARBON-ISOTOPE ANALYSIS,
Geological Survey, Denver, Colo.; and Geological Survey, Washington, D.C.
Jim D. Gleason, Irving Friedman, and Bruce B. Hanshaw.
Available from Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $3.75 per copy. Geological Survey Research 1969, Professional Paper 650-D, p D248-D250, 1969. 3 p, 1 fig, 2 tab, 3 ref.

Descriptors: *Water analysis, *Stable isotopes, *Radioisotopes, *Carbon radioisotopes, *Separation techniques, Water chemistry, Chemical precipitation, Filtration.
Identifiers: Carbon-13 analysis.

The best method for separating the dissolved carbonate species from natural water in order to determine C-13 value of carbon in the aqueous phase appears to be a direct-precipitation method. This method consists of adding ammonium hydroxide strontium chloride solution directly to the sample of natural water to be analyzed. The strontium carbonate thus formed precipitates, and is subsequently separated, dried, and analyzed for C-13. The ammonium hydroxide strontium chloride solution can absorb carbon dioxide from the air; it is therefore extremely important that both the water sample and the prepared solution not be exposed to the air during handling and filtration. Exposure for a few minutes will cause contamination and give incorrect C-13 values. (Knapp-USGS)
W70-04342

A NEUTRON SCATTERING STUDY OF WATER AND IONIC SOLUTIONS,
Union Carbide Corp., Tuxedo, N.Y.
For primary bibliographic entry see Field 01B.
W70-04347

2L. Estuaries

POTOMAC ESTUARY MATHEMATICAL MODEL,
Federal Water Pollution Control Administration, Annapolis, Md. Chesapeake Field Station.
For primary bibliographic entry see Field 05B.
W70-04077

NITRATE DISTRIBUTION IN THE SUBARCTIC NORTHEAST PACIFIC OCEAN,
Washington Univ., Seattle. Dept. of Oceanography; and Fisheries Research Board of Canada, Nanaimo, British Columbia. Pacific Oceanographic Group.
G. C. Anderson, T. R. Parsons, and K. Stephens.

Deep-Sea Research, Vol 16, p 329-334, 1969. 3 fig, 13 ref.

Descriptors: *Nitrates, *Distribution, *Pacific Ocean, *Subarctic, Seasonal, Phytoplankton, Surfaces, Depth, Primary productivity, Nutrients, Thermocline, Washington, Oregon, Coasts, Gulfs, Alaska, Velocity, Chlorophyll, Light intensity.
Identifiers: *Northeast Pacific Ocean, Isohaline zone, Bering Strait, West wind drift.

Data are presented on nitrate distribution in the subarctic Northeast Pacific Ocean. Data on other oceanographic parameters were collected simultaneously with the nitrate information and have confirmed the general oceanographic features governing production. Samples were collected during 1966 and 1967 at Ocean Weather Station P, on cruises in the North Pacific Ocean during 1964-1967 primarily for fish tagging, and during cruises of the R V Brown Bear in 1964 and 1965 off the Washington and Oregon coasts, eastward. Over most of the area nitrate is present at the surface throughout the year at a concentration above that limiting phytoplankton growth. Within coastal regions and south of about 45 degrees north, nitrate may become depleted during the spring and summer. It is suggested that maintenance of high nitrate concentrations over much of the area is due to relatively intensive entrainment of deep water into the upper zone coupled with a slow rate of nitrate removal by primary producers. Nitrate depletion in the southern area may be explained by less intensive entrainment of deep water and utilization of nutrients by a subsurface phytoplankton maximum beneath the seasonal thermocline. (Jones-Wisconsin)
W70-04188

ON THE DISTRIBUTION OF MAJOR NUTRIENTS AND PHYTOPLANKTON IN THE TAMAR ESTUARY,
Brussels Univ. (Belgium). Laboratoire de Botanique Systematique et d'Ecologie.
J. P. Mommaerts.
Journal of the Marine Biological Association of the United Kingdom, Vol 49, No 3, p 749-765, 1969. 7 fig, 2 tab, 30 ref, append.

Descriptors: *Distribution, *Nutrients, *Phytoplankton, Salinity, Phosphates, Nitrates, Silicates, Seasonal, Nannoplankton, Tidal waters, Temperature, Diatoms, Dinoflagellates, Marine algae, Littoral, Benthic flora, Brackish water, Fresh water, Scenedesmus, Trace elements.
Identifiers: *Tamar Estuary (England), Ionic composition, Exchange ratio, Evolution, Ultraplankton, Net-phytoplankton, Composition, Skeletonema, Prorocentrum, Nitzschia, Cryptomonas, Gymnodinium, Flagellates, Melosira, Navicula, Thalassiosira, Gyrodinium, Heterocapsa, Peridinium, Asterionella, Chaetoceros, Synedra, Corethron, Rhizosolenia, Dinophysis, Phaeocystis, Gonyaulax, Anabaena, Achnanthes, Cocconeis.

The Tamar estuary (England) has been surveyed from March to September 1968 for major ecological factors--especially chemical--and the nature and succession of phytoplanktonic populations in the eu-, poly- and mesohaline zones. Salinity distributions and variations were measured to provide a preliminary picture of the general circulation. Tidal flows appear to have most effect on water movement. Importance of flow and exchange ratios is emphasized. Major nutrients (phosphates, nitrates, and silicon) have been analyzed and peculiar patterns of vertical distribution are discussed. Decrease in nutrients content--with salinity 28 parts/thousand as index--is inversely correlated to the spring and summer blooming of nannophytoplankton. Distribution and evolution of various groups of phytoplankton are given. Comparison with open-sea data indicates which of the microphytoplankton is indigenous; most of the species borne from the sea cannot survive the salinity change. It is suggested that the exchange ratio controlling growth is low in the Tamar (great abundance and diversity of species, low flow ratio and the Sound as transitory region), but further studies on circulation patterns are needed to clarify this assumption. (Jones-Wisconsin)
W70-04192

PHYTOPLANKTON AND RELATED WATER-QUALITY CONDITIONS IN AN ENRICHED ESTUARY,
Geological Survey, Tacoma, Wash.
Eugene B. Welch.
Journal Water Pollution Control Federation, Vol 40, No 10, p 1711-1727, 1968. 10 fig, 27 ref.

Descriptors: *Analytical techniques, *Aquatic algae, *Aquatic microbiology, *Aquatic productivity, Biochemical oxygen demand, Cycling nutrients, Diatoms, Environmental effects, Essential nutrients, Eutrophication, Light intensity, Light penetration, Limnology, Nitrogen compounds, Nuisance algae, Nutrient requirements, Nutrients, Phosphorus compounds, Photosynthetic oxygen, Physiological ecology, Phytoplankton, Estuaries, Pollutant identification, Sewage, Sewage disposal, Sewage effluents, Water pollution control, Water pollution effects, Water pollution sources.
Identifiers: *Seattle (Wash), Renton Treatment Plant, Duwamish estuary (Wash).

Ammonia, soluble phosphate, and total phosphate concentrations were observed to increase in the Duwamish estuary, Washington, following initial discharge of effluent from the Renton Treatment Plant at Seattle. A phytoplankton bloom dominated by marine species occurred in the lower estuary in August 1965, about 1.5 months following the nutrient increase. A bloom did not occur in 1964, prior to effluent discharge from the treatment plant, but some evidence shows that algal activity was great in August 1963. The nutrient increase in 1965 probably was not the sole factor causing the bloom during that summer because: (a) the pre-effluent nutrient concentrations in 1963 and 1964 were relatively high; (b) a bloom also occurred at the furthest downstream station where no increase in nutrients was apparent in 1965 over that of the preceding two years; (c) a bloom probably occurred in 1963, before the addition of nutrients from the plant; and (d) the bloom maximum did not occur in 1965 until about 1.5 months after the nutrient increase, when discharge and tidal exchange conditions were minimum. Bloom timing seemed related most closely to hydrographic conditions. (Fitzgerald-Wisconsin)
W70-04283

THE ECOLOGY OF SHALLOW WATER MEIOFAUNA IN TWO NEW ENGLAND ESTUARIES,
Rhode Island Univ., Kingston. Graduate School of Oceanography.
John H. Tietjen.
Oecologia (Berl), Vol 2, p 251-291, 1969. 6 fig, 12 tab, 38 ref.

Descriptors: *Aquatic life, *Estuaries, Nematodes, Mollusks, Copepods, Amphipoda, Hydrogen ion concentration, Biomass, Diatoms, Chlorophyta, Chrysophyta, Bottom fauna, Nematodes, Periphyton.
Identifiers: *Meiofauna, Taxa, Subtidal meiofauna, Maldanid polychaetes, Rose Bengal, TAF, Triethanolamine formalin, Ostracods, Polychaetes, Lamellibranchs, Chlorophyll a, Turbellaria, Hydrozoa, Epigrowth feeders, Epiphytic algae, Pennate diatoms, Filter-feeding Harpactaicoidea, Vertical distribution, Niantic River estuary (Conn), Pettaquamscutt River estuary (R I).

A study made between October 1964 and October 1965, of distribution and abundance of shallow subtidal meiofauna (passing a 0.50 millimeter mesh screen and retained on a 0.074 millimeter mesh screen) in four habitats of Niantic and Pettaquamscutt estuaries in southeastern New England. Temporal changes in major taxa to changes in environment and seasonal changes with possible causes are presented. Total numbers of meiofauna varied between 1,184 and 5,163 organisms/10 square centimeters, and wet weights between 8.5 and 62.5 milligram/10 square centimeter. Nematodes were the dominant group, comprising between 58 and 90% of total fauna and 64% of the total biomass. Among the nematodes, epigrowth-feeding species were dominant at all four stations, showing marked seasonal changes in species composition. Epigrowth-feeding species reached maximum density in spring and summer and deposit and omnivorous-feeding species in fall and winter. Polychaetes, amphipods, and lamellibranchs were most abundant in the summer, while Ostracods were abundant in late summer, fall, and winter in association with detritus increase. Harpactacoid copepods were inconsistent in their seasonal distributions. Approximately 80% of all meiofauna were found in the upper 3 centimeters of sediment. (Haskins-Wisconsin)
W70-04288

THE NATIONAL ESTUARINE POLLUTION STUDY - VOLUME I.
Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 05C.
W70-04299

THE NATIONAL ESTUARINE POLLUTION STUDY - VOLUME II.
Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 05C.
W70-04300

THE NATIONAL ESTUARINE POLLUTION STUDY - VOLUME III.
Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 05C.
W70-04301

ROLE OF SALT WEDGE IN BAR-FINGER SAND AND DELTA DEVELOPMENT,
Northeastern Illinois State Coll., Chicago. Dept. of Geology.
For primary bibliographic entry see Field 02J.
W70-04306

DESCRIPTION OF A FREELY DROPPED INSTRUMENT FOR MEASURING CURRENT VELOCITY,
Nova Univ., Fort Lauderdale, Fla. Physical Oceanographic Lab.
For primary bibliographic entry see Field 07B.
W70-04310

USE OF AIR TO INFLUENCE GROUNDWATER MOVEMENT,
Dames and Moore, San Francisco, Calif.
For primary bibliographic entry see Field 02F.
W70-04358

AN ELECTRO-OPTICAL SYSTEM FOR MEASUREMENT OF MEAN AND STATISTICAL PROPERTIES OF SEDIMENT SUSPENSIONS,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 02J.
W70-04492

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

OPERATION OF A REVERSE OSMOSIS DESALINATION UNIT AT WEBSTER, SOUTH DAKOTA,
Aerojet-General Corp., El Monte, Calif.

Warren H. Bossert, and Gordon A. Fluke.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price $1.50. Office Saline Water Research and Development Progress Report No 427, May 1969. 107 p, 14 fig, 8 tab, 3 ref, 6 append. OSW Contract No 14-01-0001-1181.

Descriptors: *Water quality, *Desalination processes, *Reverse osmosis, Brackish water, Wells, Membranes, Deposition (Sediments), Flow, Operation and maintenance, Statistical methods, Model studies, Regression analysis, Potable water.
Identifiers: US Public Health Service, *Drinking water standards.

The quality of the product water obtained through reverse osmosis of brackish well waters in Webster, South Dakota met the U.S. Public Health Service Drinking Water Standards. A sharp decline in flow rate was observed during the first week of operation. This is believed to be a result of sediment deposition on the membranes. The original flow rate was not restored in spite of using various types of feedwater pretreatments. Maintenance of the plate and frame osmotic unit required less than 1% of the available operating time. Statistical analysis by fitting regression models to predict product-quantity and product-quality responses was made on a representative set of data. (Carstea-USGS)
W70-04082

SYNTHESIS AND EVALUATION OF NEW MEMBRANE CANDIDATES FOR APPLICATION IN REVERSE OSMOSIS,
Peninsular ChemResearch, Inc., Gainesville, Fla.
Thomas W. Brooks, and Carl L. Daffin.
Report available for sale by Superintendent of Documents, US Government Printing Office, Wash, DC, 20402 - Price 50 cents. Office of Saline Water Research and Development Progress Report No 460, Oct 1969. 33 p, 1 fig, 11 tab, 31 ref. OSW Contract No 14-01-0001-1260.

Descriptors: *Membranes, *Membrane processes, *Reverse osmosis, *Desalination processes, Cellulose, Osmotic pressure, Sodium chloride, Hardness (Water), Permeability, Performance, Compaction, Selectivity.
Identifiers: *Syndiotactic membranes, Acrylonitrile.

A noncellulosic synthetic polymer was shown to possess osmotic transport characteristics comparable in all respects to dense cellulose acetate. Syndiotactic poly (vinyl alcohol) membranes showed rather poor selectivity for aqueous sodium chloride feed solutions. However these membranes have shown promise for hard water applications. The attempts to improve their selectivity by grafting with acrylonitrile were not successful. The effects of grafting appeared to be a decrease in water permeability and an increase of compaction resistance. (Carstea-USGS)
W70-04083

AN EXPERIMENTAL STUDY OF THE STRUCTURE, THERMODYNAMICS AND KINETIC BEHAVIOR OF WATER,
Midwest Research Inst., Kansas City, Mo.
For primary bibliographic entry see Field 01A.
W70-04085

DEVELOPMENT OF WATER PURIFICATION SYSTEMS BASED ON REVERSE OSMOSIS,
Pratt and Whitney Aircraft, East Hartford, Conn.
R. C. Ellington.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC 20402 - Price $2.25. Office of Saline Water Research and Development Progress Report No 410, Apr 1969. 154 p, 76 fig, 27 tab, 7 ref, 4 append. OSW Contract No 14-01-0001-1113.

Descriptors: *Desalination processes, *Membranes, *Reverse osmosis, Water purification, Brackish water, Filtration, Bacteria, Scaling, Porous media, Performance, Hydrodynamics.
Identifiers: Polarization effects, Feedwater.

The performance of compact desalination membrane cartridges consisting of three composite membranes with variable surfaces was tested. The concentration polarization effects were very small. Reverse-osmosis membranes reinforced with nylon cloth were also tested for brackish waters. Feedwater pretreatment, such as filtration and bacteria removal, should be incorporated into all test systems as membrane fouling and scale buildup may affect membrane performance. Compaction studies should be extended to determine if membrane performance is either linear or logarithmic with respect to time. An endurance test performed on the compact cartridge and on individual membranes should be between 1,500 and 5,000 hours. The hydrodynamics of a number of porous support materials and structures were evaluated. (Carstea-USGS)
W70-04086

THE SECONDARY REFRIGERANT FREEZING PROCESS: A MATHEMATICAL STUDY,
Research Triangle Inst., Durham, N.C.
John C. Orcutt, Forest O. Mixon, and Francis J. Hale.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC - Price $1.25. Office Saline Water Research and Development Progress Report No 365, July 1968. 158 p, 23 fig, 11 tab, 40 ref, 6 append. OSW Contract No14-01-0001-960.

Descriptors: *Desalination processes, *Mathematical models, *Freezing, Economics, Analog computers, Crystal growth, Pilot plants, Temperature, Operating costs, Operation and maintenance, Columns, Optimization.
Identifiers: *Secondary refrigerant freezing process.

Mathematical models of the major system components were used to describe the secondary refrigerant freezing desalination process. The operational-design economics of a freezing process and the prediction of the best operating conditions were studied by mathematical equations with the aid of computers. The mixing characteristics of the freezer and the formation of crystals were studied in pilot plant experiments. A mathematical model for wash column operation was made with the aid of laboratory experiments on a small, rectangular wash column. Process operation economics were largely dependent upon the temperature maintained in the freezer and the overall difference in refrigerant and equilibrium temperature. The analog computer substantiated the findings of the dynamic analysis of the freezer. (Carstea-USGS)
W70-04088

THE FREEZING PROCESSES: BUTANE HYDRATES AND ANISOTROPIC POROUS MEDIA,
Syracuse Univ., N.Y.
Allen J. Barduhn, Olivier S. Rouher, and Daniel J. Fontugne.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC - Price $0.30. Office Saline Water Research and Development Progress Report No 366, p 1-15, Oct 1968. 15 p, 3 fig, 6 tab, 11 ref. OSW Grant No 14-01-0001-1135.

Descriptors: *Freezing, *Hydrate processes, *Desalination processes, Porous media, Hydrates, Permeability, Salts, Temperature, Thermodynamic behavior.
Identifiers: *Butane hydrates.

N-butane does not form a hydrate by itself at atmospheric pressures. The phase diagram for pure iso-butane hydrate shows the critical decomposition conditions to be 1.88 deg C and 1256 mm. The other thermodynamic properties studied were the heat of formation, the depression of the formation temperatures by salt, and the hydrate composition. The hydrate-forming capabilities of mixtures of iso and normal butane were determined. The design, construction and testing of an improved device for determining permeabilities of porous beds in two directions are discussed. (Carstea-USGS)
W70-04089

DEVELOPMENT OF ULTRATHIN SKIN MEMBRANES-HEMA POLYMERS,
Massachusetts Inst. of Tech., Cambridge.
A. S. Hoffman, and M. Modell.
Report available for sale from Superintendent of Documents, US Government Printing Office, Wash, DC 20402 - Price $0.55. Office Saline Water Research and Development Progress Report No 374, Dec 1968. 30 p, 10 fig, 8 tab, 13 ref. OSW Grant No 14-01-0001-1256.

Descriptors: *Reverse osmosis, *Desalination processes, *Membranes, Sorption, Membrane processes, Water transfer, Diffusion, Diffusivity, Permeability.
Identifiers: Desalination membranes, N-methylol acrylamide, Acrylic acid, Ethyl acrylate, Trimethylol propane.

A new class of desalination membranes has been developed, characterized and tested under reverse osmosis conditions. Prepared by polymerizing mixtures of N-methylol acrylamide, acrylic acid, ethyl acrylate and trimethylol propane trimethacrylate followed by heat treatment, the membranes are essentially homogeneous, averaging about 6 mills in thickness. The membranes were characterized by measuring their sorption of water and salt when immersed in salt solution at ambient conditions. Reverse osmosis performance was evaluated at various pressures and salt concentrations. Best results indicate performance capabilities slightly better than dense cellulose acetate (39.8% acetylated) under comparable conditions. Salt and water transport mechanisms are interpreted in terms of solution at the membrane interface followed by activated diffusion of primary water or secondary water and its salt through the membrane. In terms of this model, certain changes in membrane composition or heat treatment cause much sharper drops in salt and secondary water diffusivities. This analysis permits prediction of new membrane compositions which should exhibit higher fluxes and even better permselectivity to water over salt. (Carstea-USGS)
W70-04090

PHYSICAL PROPERTIES OF SEA WATER SOLUTIONS: HEAT CAPACITY,
National Engineering Lab., East Kilbride (Scotland).
For primary bibliographic entry see Field 01A.
W70-04325

DESALINATION BY FREEZING - AN INVESTIGATION OF ICE PRODUCTION FROM BRINE IN A CONTINUOUS CRYSTALLIZER,
Massachusetts Inst. of Tech., Cambridge.
T. K. Sherwood, P. L. T. Brian, and A. F. Sarofim.
Available from Superintendent of Documents, U S Government Printing Office, Wash, D C - Price $1.25 per copy. Office of Saline Water Research and Development Progress Report No. 474, Sept 1969. 145 p, 27 fig, 9 tab, 60 ref, 5 append. OSW Grants Nos 14-01-0001-546, 14-01-0001-1719.

Descriptors: *Desalination processes, *Freezing, *Crystal growth, *Ice, Brines, Instrumentation, Permeability, Slurries, Particle size, Particle shape, Heat transfer, Nucleation, Porosity.
Identifiers: Continuous crystallizer, Ice beds.

Crystallizer operation and the suitability of the ice product for washing to remove brine in an ice-piston wash column desalination process were investigated. The permeability of ice beds formed from the ice slurries was measured. The ice particles have a disk-like shape with a thickness-to-diameter ratio of about 0.34. Most of the ice particles have a diameter between 0.6 and 0.8 mm, with

very few particles smaller than 0.4 mm or larger than 2 mm. The principal thermodynamic loss in freezing is due to the temperature difference required to transfer heat from brine to refrigerant. Permeabilities of ice beds formed from the product slurries increased sharply with bed porosity. Somewhat higher permeabilities were found at the highest slurry densities. Population balance, growth rates and nucleation rates of ice particles are also discussed. (Carstea-USGS)
W70-04346

3B. Water Yield Improvement

HYDROLOGICAL DOCUMENTATION FOR THE EXPLOITATION OF RESERVOIRS IN PERMEABLE SOLID ROCKS FOR THE PURPOSE OF ARTIFICIAL INFILTRATION,
Hydraulic Research Inst., Prague (Czechoslovakia).
Vaclav Zajicek.
Artificial Recharge and Management of Aquifers, Symposium of Haifa, Mar 19-26, 1967, International Association of Scientific Hydrology, Publication No 72, p 124-131, 1967. 8 p, 4 fig, 1 tab, 5 ref.

Descriptors: *Hydrologic data, *Surveys, *Data collections, *Reservoir design, *Reservoir leakage, Water storage, Aquifers, Aquifcludes, Artesian wells, Water yield, Groundwater movement, Reservoirs, Dams, Surface-groundwater relationships.
Identifiers: Czechoslovakia.

An approach to choosing valley sites for storage reservoirs is outlined. In the representative area of Czechoslovakia a dense network of hydrogeological probes was developed covering an area of several square kilometers, to study the permeable layer and its discharge in large springs at defects in the artesian ceiling. Other hydrological surveys supply data on the direction and velocity of flow, on the filtration and storage capacity of the rocks, and also on their effect on the water quality. This proves the feasibility of dual storage with the construction of impounding reservoirs and other similar reservoirs in the infiltration zone of some aquifers if the filtration losses appear as a positive item in the budget of artesian aquifers. A combination of surface and underground storage has a favorable effect also from the point of view of evaporation. (Knapp-USGS)
W70-04118

THE STORAGE CAPACITY IN THE DUNE-WATER CATCHMENT AREA OF AMSTERDAM AND ITS EFFECT ON THE WATER QUALITY,
Municipal Waterworks of Amsterdam (Netherlands).
K. D. Venhuizen.
Artificial Recharge and Management of Aquifers, Symposium of Haifa, Mar 19-26, 1967, International Association of Scientific Hydrology, Publication No 72, p 109-123, 1967. 15 p, 2 fig, 10 chart, 1 tab.

Descriptors: *Recharge, *Sands, *Water yield, *Water quality, Aquifers, Dunes, Water table, Canals, Drainage, Water levels, Water-level fluctuations, Saline water intrusion, Water storage, Induced infiltration, Surface-groundwater relationships.
Identifiers: *Netherlands.

The dunewater catchment area of Amsterdam is situated south of Zandvoort and covers approximately 3650 ha. Extraction of water was started in 1853 by means of open canals, and later by means of wells. By 1915 the amount of the extraction equaled the total effective rainfall. After that more water was extracted than percolated in the area. Since 1957 part of this area has been recharged with prefiltered water from the River Rhine, transported by a pipeline with a total length of 53 km. The infiltration water is captured by means of horizontal drains which carry it to the open canals. At present the infiltration area is about 430 ha and the capacity is 70 million cu m a year. In another part of the dunes storage canals have been built with a total storage capacity of 10 million cu m. The infiltration area combined with the storage capacity and the well-system have a probable aggregate capacity at 82 million cu m a year. By mixing the types of water it is possible to influence the quality of the final product. (Knapp-USGS)
W70-04121

SAGEBRUSH CONVERSION TO GRASSLAND AS AFFECTED BY PRECIPITATION, SOIL, AND CULTURAL PRACTICES,
Geological Survey, Denver, Colo. Water Resources Div.
L. M. Shown, R. F. Miller, and F. A. Branson.
Journal of Range Management, Vol 22, No 5, p 303-311, Sept 1969. 9 p, 5 fig, 2 tab, 14 ref.

Descriptors: *Range management, *Land management, *Revegetation, *Vegetation establishment, *Sagebrush, Watershed management, Cultivation, Grasses, Grazing, Forages, Range grasses, Brush control, Vegetation regrowth.
Identifiers: Sagebrush conversion, Grass establishment.

The most successful conversions of sagebrush to crested wheatgrass, in areas of the Western United States that receive an average of 8 to 14 inches of precipitation annually, usually occur where the annual precipitation exceeds 10 inches and on soils having medium moisture-holding capacities. Conversion results were intermediate on coarse soils having low moisture-holding capacities and comparatively poor on fine soils having high moisture-holding capacities. Degree of grass establishment varied directly with the big sagebrush vigor-index. Grass production was lower on gravelly sites converted from black sagebrush than on nearby sites converted from big sagebrush. Cheatgrass hindered the establishment of crested wheatgrass in some places. Conversion results were poor on sites where greasewood or shadscale was mixed with sagebrush. These halophytes had usually reestablished on the treated sites. (Knapp-USGS)
W70-04322

EFFECTS OF WEATHER MODIFICATION ON PLANT AND ANIMAL COMMUNITIES,
Michigan Univ., Ann Arbor. School of Natural Resources.
For primary bibliographic entry see Field 02B.
W70-04391

RATIONAL UTILIZATION OF MEXICO'S WATER RESOURCES (IN SPANISH),
Secretaria de Recursos Hidraulicos (Mexico).
For primary bibliographic entry see Field 06B.
W70-04408

3D. Conservation in Domestic and Municipal Use

COOPERATION BY CITIES OF 100,000 INHABITANTS AND MORE WITH DRAINAGE DISTRICTS, ETC., FOR FLOOD PROTECTION.

Mo Ann Stat secs 70.330 thry 70.360 (1952).

Descriptors: *Missouri, *Cities, *Drainage districts, *Sewers, Legislation, Local governments, Watershed management, Flood control, Watersheds (Basins), Punlic health, Environmental sanitation, Conveyance structures, Natural streams, Overflow, Flood damage, Eminent domain, Right-of-way, Assessments, Cost-benefit theory, Costs, Cost repayment, Stream improvement, Cost allocation, Levees, Construction.

Cities with more than one hundred thousand inhabitants amy contract with local drainage districts or other public corporations for cooperation or joint action in building sanitary and storm sewers in watersheds common to such cities and districts. These cities may also contract to construct levees or improve any natural watercourse to prevent overflow from injuring lands situated within their territorial limits. These cities may contract with the United States, private corporations, and any individuals owing lands subject to injury by overflow or in need of sewers. Where a watershed is located partially within an adjoining state, the preceeding activities may be carried on with the consent of the adjoining state if the public health and safety so require. These cities may acquire rights of way by purchase or eminent domain for any such sewers or watercourse improvements. The cities may pay for these works and rights of way out of their general funds or by imposition of special assessments upon benefited lands. (Schram-Florida)
W70-04230

MUNICIPALLY OWNED UTILITIES: CITIES SUPPLIED WITH WATER FROM OTHER CITIES.
Mo Ann Stat secs 91.050 thru 91.080 (1952).

Descriptors: *Missouri, *Water works, *Water supply, *Local governments, Public utilities, Pipelines, Water delivery, Contracts, Condemnation, Eminent domain, Condemnation value, Easements, Right-of-way, Water distribution (Applied), Cities.

Any city in the state which owns and operates a waterworks system may supply water to other municipalities and to persons beyond the corporate limits of the city. Any city having authority to maintain waterworks may procure water from another city for that purpose and may lay pipelines and install all machinery needed to convey the water from the supplying city. Every city to be supplied with water from another city may condemn a right of way to and from the supplying city. (Dearing-Florida)
W70-04466

WATER UTILITY COST TRENDS,
Dade County Water and Sewer Board, North Miami Beach, Fla.; Whitman, Requardt and Associates, Baltimore, Md.; and Cast Bay Municipal Utility District, Oakland, Calif.
Stanley L. Cohen, C. Ernest North, and Charles B. Adelman.
American Water Works Association Journal, Vol 60, No 2, p 129-134, February 1968. 6p, 2 ref.

Descriptors: *Costs, *Interest rates, *Financing, Inflation, Wages, Water supply, Budgeting, Fringe benefits, Labor, Investment, Management, Water rates, Profits, Debt, Industrial production, Population.
Identifiers: *Depreciation, *Trending method.

Three basic topics are discussed, the first being the interest rate costs in water utilities. The need for large amounts of capital for water treatment and supply facilities is stressed as well as the increasing cost of that capital. The dilemma that this poses to the water utility faced with artificially low water rates is discussed. The second section is concerned with depreciation and the problem of estimating depreciation with respect to the true purpose of depreciation, (i.e., to recover the original investment). The method currently in use is poor and the article proposes the trending method as producing better results. The third section deals with the cost of labor and material in water utilities. This final section discusses the rising cost of labor, the use of indexes, the cost effects of fringe benefits and the implications of inflation for water costs. (Murphy-Rutgers)
W70-04524

MUNICIPAL CORPORATIONS.

Ohio Rev Code Ann sec 717.01 (Page 1953), as amended, (Supp 1970).

Descriptors: *Ohio, *Cities, *Water works, *Sewers, Legislation, Wharves, Navigable waters, Sewage disposal, Waste water disposal, Drains, Ditches, Levees, Dams, Watershed management, Water supply.

Municipal corporations are empowered to: construct wharves and landings on navigable waters; acquire waterworks, which may extend beyond the municipal limits; construct sewers, disposal works, drains and ditches, construct and improve levees, dams waterfronts and any watercourse within its boundaries; and acquire land and water rights necessary for the protection of watersheds. (Douberley-Florida)
W70-04525

COMPARISON OF COSTS OF REMOTE CONTROL AND MANUAL OPERATION,
Gary-Hobart Water Corp., Gary, Ind.
For primary bibliographic entry see Field 06C.
W70-04528

WATER SUPPLY.

Mo Ann Stat sec 88.633 (1952).

Descriptors: *Missouri, *Water supply, *Water works, *Administration, Hydrants, Water allocation, Water conveyance, Water delivery, Water distribution, Water management (Applied), Water policy, Water rates, Water resources development, Local governments, Political aspects.

The city council of a third class city may make contracts for furnishing the city with water, fire hydrants and public fountains. No such contract shall be for more than twenty years. No contract is valid until ratified by vote of two-thirds of the qualified voters. The council is empowered to erect and maintain water works for the city and to regulate the rates charged for water. The council may acquire by condemnation, donation, or purchase lands necessary for the operation of water works. The council may grant the right to operate water works to any person or corporation. The granting of such right must be ratified by a majority of qualified voters. Contracts entered before enactment of this statute and not ratified by the voters are not invalidated by the statute. (Dye-Florida)
W70-04537

MUNICIPALLY OWNED UTILITIES: WATERWORKS.
Mo Ann Stat secs 91.593 thru 91.610 (1952).

Descriptors: *Missouri, *Water works, *Public utilities, *Local governments, Pipes, Buildings, Easements, Right-of-way, Condemnation, Condemnation value, Eminent domain, Water supply, Municipal water, Financing, Pumping plants, Compensation, Water distribution (Applied), Distribution systems, Contracts, Land tenure, Legislation.
Identifiers: *Revenue bonds.

Certain cities which own and operate a waterworks system may acquire and maintain property and facilities outside the city limits when necessary for connecting with emergency water supplies or for furnishing water to persons outside the city limits. These cities may issue revenue bonds, following specified procedures, for the repair or improvement of their waterworks systems. Every such city may take, hold, use, and dispose of real and personal property as necessary to provide waterworks for the city. No property may be taken or damaged, however, without payment of just compensation to the owner. (Dearing-Florida)
W70-04539

3E. Conservation in Industry

GEOLOGICAL SURVEYS AND WATER RESOURCES; GEODETIC SURVEYS.

Mo Ann Stat secs 256.010 thru 256.160 (1959), as amended, (Supp 1970).

Descriptors: *Missouri, *Geological surveys, *Water resources, *Administrative agencies, Groundwater, Mineralogy, Compensation, Costs, Federal government, Clays, Rocks, Natural gas, Maps, Conservation, Construction, Education, Damages, Water supply, Subsurface waters, Chemical analysis, Surface waters, Supervisory control (Power), Water resources development.
Identifiers: Penalties (Civil).

The Governor is authorized to appoint a competent state geologist to direct a geological survey. The state geologist may appoint assistants to make a thorough scientific, geological, and mineralogical study of the state. The Governor shall have general supervisory control of the Division of Geological Survey and Water Resources. All employees of the Division shall abstain from private consulting activities. Priorities in the Survey include studies of geological formations, mineral deposits, and the arrangement, composition and utilization of ores, clays, natural gas, surface and groundwaters, and other mineral substances. The state geologist is directed to prepare statistical reports and topographical maps, and to apply geologic engineering principles to problems of agriculture, conservation, and construction. He is also authorized to make a survey of the state's water resources. Information gathered shall be made available to the news media and educational institutions. The Division may authorize additional technical work, and may cooperate with federal agencies. Geodetic surveyors may enter state lands to effect the objects of the federal act. Compensation is to be paid for damages done by surveyors and procedures are set forth for determining adequate compensation. (Duss-Florida)
W70-04228

POWERS OF GAS, ELECTRIC OR WATER COMPANIES.

Mo Ann Stat secs 393.010 thru 393.030, 303.050 (1952), as amended, (Supp 1970).

Descriptors: *Missouri, *Public utilities, *Electric power industry, *Water works, Legal aspects, Legislation, Cities, Industries, Water distribution (Applied), Urbanization, Utilities, Condemnation, Eminent domain, Construction, Electric power production, Right-of-way, Water conveyance, Water delivery, Consumptive use, Distribution systems, Water allocation (Policy).

Corporations organized to supply gas, electricity or water are authorized to set their poles, piers, abutments, wires and other fixtures along, across, or under any Missouri waters in such a manner as not to incommode the public use of such waters. Such corporations are authorized to lay and construct underground water mains across any Missouri streams for the purpose of furnishing water supply. Any corporation, company or individual proposing to supply any city, town, or village with water is authorized to take water from any non-navigable stream and to erect a dam thereon. Any such water corporation may acquire by condemnation sufficient lands to lay pipes for the conveyance of water in, over, or through lands situated beyond the water supply source. Any such water corporation may also acquire by condemnation sufficient lands upon which to drill wells to provide an adequate water supply from underground sources. Sufficient lands upon which to build, construct, install and operate facilities for the processing, pumping, storage distribution and water management may be acquired by condemnation. (Powell-Florida)
W70-04236

3F. Conservation in Agriculture

ECONOMICS OF GROUNDWATER DEVELOPMENT IN THE HIGH PLAINS OF COLORADO,
Colorado State Univ., Fort Collins. Natural Resources Center.
For primary bibliographic entry see Field 04B.
W70-04049

IMPROVING EFFICIENCY IN AGRICULTURAL WATER USE,
Colorado State Univ., Fort Collins. Natural Resources Center.
W. Doral Kemper, and R. E. Danielson.
Available from the Clearinghouse as PB-189 784, $3.00 in paper copy, $0.65 in microfiche. Colorado State Univ, Natural Resources Center, Partial Completion Report, June 30, 1969. 5 p, 9 ref. OWRR Project A-002-COLO.

Descriptors: *Water conservation, *Microwatershed, *Irrigation effects, *Moisture stress, *Runoff management, Water management, Evapotranspiration, Crop response, Growth rates, Moisture uptake, Water yield.

Management of runoff under dry land cropping was attempted by collecting precipitation from sealed surfaces 4 ft. to 10 ft. wide on untreated crop strips 18 in. wide. In the dry years of 1966 and 1968, when only six and eight inches of water were avaiable, respectively, (soil storage plus rainfall) yields from microwatersheds were five times yields on untreated check areas. Crops grown included corn, sugar beets, and sweet corn. During the four-year study period, 1967-1969, with an average of 8.5 in. of moisture available, corn on the treated plots yielded 68 bushels per acre compared to 32 bushels per acre from the untreated area. In 1968 when 8 in. of moisture was available, sweet corn on microwatersheds yielded 924 ears per acre compared to 165 ears per acre from the check. Sugar beets yielded 9 tons per acre compared to 3 tons per acre on the check. In 1967 with 11 in. of moisture available, beets on the microwatersheds yielded 12 tons per acre compared to 11 tons per acre on the check. An evaluation of several possible waterproofing or infiltration reducing covers for the microwatersheds were made. Controlling water stress by irrigation scheduling reduced evaporation 61 percent while yields were reduced only 36 percent compared to maximum yields under ideal moisture stress conditions.
W70-04058

SOIL CONSERVATION DISTRICTS.
For primary bibliographic entry see Field 04D.
W70-04221

DRAINAGE AND SOIL CONSERVATION.
For primary bibliographic entry see Field 04D.
W70-04223

MISSOURI WATERSHED PROTECTION AND FLOOD PREVENTION LAW.
For primary bibliographic entry see Field 04D.
W70-04232

AN EVALUATION OF RANGE FLOODWATER SPREADERS,
Geological Survey, Denver, Colo. Water Resources Div.
R. F. Miller, I. S. McQueen, F. A. Branson, L. M. Shown, and Wm. Buller.
Journal of Range Management, Vol 22, No 4, p 246-257, July 1969. 12 p, 14 fig, 1 tab, 22 ref.

Descriptors: *Range management, *Water spreading, *Flood irrigation, Recharge, Erosion, Erosion control, Vegetation effects, Drainage, Water storage, Water yield, Flood control, Hydrographs.
Identifiers: Floodwater spreading.

Range floodwater spreaders are systems of dikes constructed to automatically divert floodflows from gullies and spread them over adjacent range land. The primary purpose of the investigation was to determine what factors influence vegetal response to this supplemental moisture. Forage was established and produced only on sites that received at least one flooding per year. Forage production per unit of water was less when water was ponded and could not drain completely from the soil surface. The total moisture retention capacity of the A and B horizons had more influence than soil texture on the amount of forage produced. (Knapp-USGS)
W70-04324

PASTURE IMPROVEMENT IN THE DESERT ZONES OF UZBEKISTAN,
National Science Foundation, Washington, D.C. Special Foreign Currency Science Information Program.
L. Gaevskaya, Z. Shamsutdinov, and M. Sosnina.
Translation of Uluchsheni E Pastbishch i Sozdanie Senokosov v Pustynnoi Zone Vzbekistana. Available from the Clearinghouse as TT 69-55076. Israel Program for Scientific Translations, Catalog No. 5508; Jerusalem, 1969. 49 p, 26 fig, 4 tab, 38 ref.

Descriptors: *Arid lands, *Pasture management, *Sheep, *Grazing, *Forages, Plant pathology, Browse utilization, Range management, Deserts, Rotations, Seeds, Pest control.
Identifiers: *Uzbekistan, USSR.

Sparse forage vegetation is a major problem in the arid-land sheep pastures of Soviet Central Asia. This situation is often aggravated by either undergrazing or overgrazing the range. In an attempt to relieve the forage problem, measures were introduced utilizing plant pest and disease control, more efficient grazing systems, short- and long-term pasture improvement, and dry-land fodder production. The effects of each of these programs is discussed, but no overall conclusions are drawn. (Carr-Arizona)
W70-04398

SALT AND WATER MOVEMENT INTO SOLONETZIC SOILS,
Department of Agriculture, Lethbridge (Alberta). Research Station.
For primary bibliographic entry see Field 02G.
W70-04400

TRANSPIRATION, EVAPORATION AND DEEP DRAINAGE LOSSES FROM AN ORANGE PLANTATION,
National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research.
J. D. Kalma, and G. Stanhill.
Israel Journal of Agricultural Research, Vol 19, No 1, p 11-24, January 1969. 3 fig, 3 tab, 23 ref.

Descriptors: *Semiarid climates, *Evaporation, *Irrigation practices, *Drainage effects, *Evapotranspiration, Irrigation water, Precipitation (Atmospheric), Deep percolation, Orchards, Oranges, Water loss, Sprinkler irrigation, Soil water, Moisture content, Canopy, Throughfall, Water balance, Soil surfaces, Measurement, On-site data collections, Evaporation pans.
Identifiers: *Israel.

A mature orange orchard on the Israeli coastal plain was the site of an intensive one-year study of water loss. Total water income amounted to 569 mm of precipitation and 483 mm of irrigation water. Total water loss consisted of 206 mm of deep drainage and 850 mm of evapotranspiration. Of this latter, 217 mm (26%) was evaporation from the bare soil. It was calculated that if an above-canopy sprinkler system were substituted for the current below-canopy type, total annual water loss would increase by 44 mm. A subsurface irrigation method would decrease water loss by leaving the upper soil layer dry. The estimated reduction of evaporation amounted to 32 mm. (Carr-Arizona)
W70-04402

EFFECTS OF IRRIGATION REGIMES ON GRAPEFRUIT PEEL AND PULP RELATIONSHIPS,
National and Univ. Inst. of Agriculture, Rehovoth (Israel). Volcani Inst. of Agriculture Research.
For primary bibliographic entry see Field 02I.
W70-04403

A WORLD GEOGRAPHY OF IRRIGATION,
Leonard M. Cantor.
Praeger Publishers, New York, Washington, 1970, 252 p, 60 fig, 41 plates, 158 refs, Index.

Descriptors: *Irrigation, *Agriculture, *Arid lands, *Economic impact, *Social aspects, Semiarid climates, Surface waters, Groundwater, Water supply, Irrigation practices, History, United States.
Identifiers: *Geography, Asia, Africa, Latin America, USSR, Europe, Southwest Asia, Australia.

Although irrigated areas of the world have nearly doubled in 20 years, agricultural production has not risen correspondingly. This partly owing to complex social, physical, economic and geographic factors. This book provides the student of geography with a broad picture of irrigated agriculture throughout the world. Although most of the work is concerned with irrigation in arid or semiarid climates, it also reviews supplemental irrigation practices in such areas as monsoon Asia and western Europe. The first section of the volume is devoted to the history of irrigation and its social and economic aspects. The second part reviews the development and current practices of irrigation in each geographic region of the world. (Crouse-Arizona)
W70-04404

EFFECT OF THE PRECEEDING CROP AND AGRONOMIC PRACTICE ON SORGHUM (SORGHUM BICOLOR L. MOENCH) AND GROUNDNUTS (ARACHIS HYPOGAEA L.) IN THE CENTRAL SUDAN,
Agricultural Research Service, Athens (Greece).
P. A. Gerakis, and C. Z. Tsangarakis.
Agronomy Journal, Vol 61, No 5, p 681-683, September-October, 1969. 4 tab.

Descriptors: *Sorghum, *Rotations, *Semi-arid climates, *Fallowing, *Soil moisture, Crop production, Fertilizers, Nitrogen.
Identifiers: *Central Sudan, *Bare fallow, *Groundnuts.

In order to devise an improved rotation policy, an experiment was conducted in the Central Sudan to study effect of previous cultivation on the subsequent sorghum and peanut crop. The use of bare fallow the first year in order to increase soil moisture for the second was also investigated. Except for the top 0.15 meters of soil, soil moisture was significantly higher in bare fallow as compared to weed fallow plots. Moisture increase was not reflected in the yield of either crop. This should not preclude further experimentation with the bare fallow technique, especially in the cultivation of very deep-rooted species. (Carr-Arizona)
W70-04405

ROW SPACING AND FERTILIZATION INFLUENCES ON FORAGE AND SEED YIELDS OF INTERMEDIATE WHEATGRASS, RUSSIAN WILDRYE, AND GREEN NEEDLEGRASS ON DRYLAND,
Agricultural Research Service, Sidney, Mont. Northern Plains Soil and Water Research Center; and Montana Agricultural Experiment Station, Bozeman.
For primary bibliographic entry see Field 02I.
W70-04406

MOISTURE CONTENT OF COTTON LEAVES AND PETIOLES AS RELATED TO ENVIRONMENTAL MOISTURE STRESS,
Texas A and M Univ., College Station; and Texas Agricultural Experiment Station. El Paso.
For primary bibliographic entry see Field 02I.
W70-04407

AGRARIAN STRUCTURE IN THE PIEDMONT OASES OF TARAPACA PROVINCE (IN SPANISH),
Universidad Catolica de Valparaiso (Chile). Departamento de Geografia.
Osvaldo Ossandon.
Revista Geografica de Valparaiso Vol 1, No 1, p 41-62, 1967. 3 fig, 3 tab, 14 ref.

Descriptors: *Land tenure, *Arid lands, *Agriculture, *Social Impact, *Economic Impact, Horticultural crops, Irrigation.
Identifiers: *Tarapaca Province, *Chile, *Oases.

This contribution is part of a regional analysis of Chile's arid Norte Grande which when completed, will give a scientific basis for regional plans and local research in order to utilize to the best possible degree valuable resources or alternate means in areas where lack of resources is an impediment to development. History of land ownership, extent of cultivation, number of ranches and availability of water are discussed at length. One oasis village--Matilla-- is treated in depth, indicating agricultural production, irrigation and problems resulting from continued partioning of land into increasingly smaller parcels. (Moore-Arizona)
W70-04410

SETTLEMENTS NEAR THE ARID MARGIN OF CULTIVATION, NORTHEAST AFRICA (IN GERMAN),
Martin Born.
English Summary. Geographische Zeitschrift, Vol 55, No 4, p 243-278, 1967. 9 maps, 36 refs.

Descriptors: *Arid lands, *Flash floods, *Flood irrigation, *Impoundments, Cotton, Dry farming, Dunes, Forages, Irrigation, Irrigation practices.
Identifiers: *Nomads, *Red Sea Hills, Sudan.

Expansion of cropland in the marginal land adjacent to the very arid portions of East Africa, among the Red Sea Hills, has had a marked effect on the nomads of the area. Cultivation of such areas is dependent on accommodation to a rainfall of less than 200 mm through devices for impoundment of surface water and flood irrigation. The camel-owning tribes of this region are less nomadic than other Sudan tribes, and practice a limited type of agriculture, mostly cotton and forages. As the degree of aridity increases, agricultural development becomes more restricted. Attempts to control flash floods are less than successful, and uncertain rainfall creates a situation unsuited to any more intensive type of farming. Yet the pressures of population, both human and herds, cannot be solved without greater attention to either severely limited numerical control of both, or a more highly sophisticated attack on the technological problems of an exceedingly stressful environment, or both. (Paylore-Arizona)
W70-04411

KHARGA, FROM THE OASIS MAGNA TO THE NEW VALLEY (IN GERMAN),
Heinz Schamp.
Summary in English. Die Erde, Vol 98, No 3, p 173-202, 1967. 1 fig, 54 refs.

Descriptors: *Irrigation, *Deserts, *Water resources development, *Groundwater basins, *Deep-well pumping, Wells, Land resources, Community development, Economic impact, Social aspects, Soil profiles, Arid lands, Water sources, Arable land.
Identifiers: *Oases, *Kharga Oasis, Egypt.

Kharga, one of the largest of the Egyptian oases, was included in the area of the Western Desert selected by Egyptian Government's General Desert Development Organization for land reclamation and resettlement. The first 5-year program (1960-1965) provided approximately 100 deep wells, furnishing irrigation water for the cultivation of some 45,000 feddans (1 feddan = 1.04 acres) as compared with only 6,000 formerly. Although the origin of the groundwater in the Kharga oasis area is not yet identified, current estimates from known supplies indicate that even larger acreage may be brought under cultivation. Topics discussed include groundwater, soils, a history of the oasis detailing recurring desertification, the cost of financing the New Valley project, and settlement problems. The latter topic seeks to compare the old oasis villages with the new settlements, characterized by an influx of new population types: technicians, engineers, and the like. The extreme desertic conditions of the surrounding environment make the Kharga Oasis development one of great general interest, since its success could provide a pilot for similar water-short areas throughout the arid world. The element of its water potential is the critical factor. (Paylore-Arizona)
W70-04412

SOLAR BATTERIES AND AGROECONOMY OF DEVELOPING NATIONS,
Jadavpur Univ., Calcutta (India). Dept. of Electronics and Telecommunication Engineering.
S. Deb, and M. K. Mukherjee.
Indian Journal of Scientific and Industrial Research, Vol 28, No 3, p 81-84, March 1969. 2 tab, 23 ref.

Descriptors: *Irrigation, *Irrigation engineering, *Solar radiation, *Electric power production, *Electric power costs, Irrigation wells, Electric power, Arid lands, Semiarid climates, Agriculture, Economic impact, Energy, Generators, Costs.
Identifiers: *Solar batteries, *Deep-tube wells, India.

Use of solar energy for generating electrical power is of great interest to areas in which there is abundant sunlight but scanty water supply. Irrigation using conventional methods of power generation has some associated difficulties from which solar power would be free. Unfortunately, present solar cells are expensive and incapable of uniform output. The probable details and cost were worked out for a solar battery capable of operating a deep-tube well for irrigation. If present research is able to reduce the cost of solar cells, savings of up to 50% would be possible when compared with conventional power. Considering the importance of irrigation to the economies of developing nations, further research in this field should be encouraged. (Carr-Arizona)
W70-04413

SPRINKLERS AND VEGETABLE CROP MECHANIZATION IN DESERT AREAS,
California Univ., Riverside. Agricultural Extension Service.
Hunter Johnson, Jr., Albert W. Marsh, G. Neil McRae, and Phillip G. Mowbray.
Agricultural Engineering, Vol 51, No 1, p 20-21, January 1970. 1 fig.

Descriptors: *Sprinkler irrigation, *Crop production, *Seeds, *Saline soils, *Vegetable crops, Salt tolerance, Germination, Arid lands, Deserts, Irrigation systems, Furrow irrigation, Temperature, Irrigation efficiency.
Identifiers: *Cabbage, Romaine, Precision planting.

Sprinkler irrigation substantially improves germination and emergence of romaine and cabbage seed. The results are attributed to seed salt zone control. Sprinkler plots were found to have conductivities of from 3 to 4 mmhos in the top inch of soil, compared to 15 to 20 mmhos for furrow-irrigated plots. These findings indicate that precision planting on saline soils could be practical. Sprinklers would be the first step in mechanized culture of vegetable crops, especially in desert areas. (Carr-Arizona)
W70-04415

SPRINKLER FERTILIZATION AND PLANT DAMAGE,
Agricultural Research Service, Kimberly, Idaho. Snake River Research Center; and Idaho Univ., Moscow. Agricultural Experiment Station.
C. L. Douglas, Claude H. Pair, and J. Hamilton Smith.
Agricultural Engineering, Vol 50, No 11, p 687, November 1969. 1 fig.

Descriptors: *Fertilization, *Application methods, *Crop response, *Sprinkler irrigation, *Damages, Crop production, Ammonium compounds, Ureas, Potatoes, Sugar beets, Wheat, Spraying, Fertilizers.
Identifiers: *Plant damage.

Fertilizing plants by sprinkler irrigation is simple and rapid. Unfortunately there is the possibility of high fertilizer concentrations damaging the plant unless fertilizer is rinsed from the leaves. Potatoes, sugar beets, and Lemhi wheat were grown in order to determine safe concentrations of sprinkler - applied fertilizer. Plants were fertilized weekly with ammonium nitrate or ammonium nitrate and urea. Potatoes showed no sign of damage up to 1500 ppm with ammonium nitrate and up to 2000 ppm with nitrate and urea (these were the maximum amounts tested). Sugar beets and wheat also showed no sign of damage up to the limits of the experiment, 2000 ppm of ammonium nitrate. Although these were greenhouse tests, they do indicate that a farmer could sprinkler fertilize at almost any economical rate without damage to his crop. (Carr - Arizona)
W70-04419

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

PHYSICAL, LEGAL AND ECONOMIC ASPECTS OF ASSESSMENT OF COSTS AMONG DRAINAGE DISTRICTS: LEGAL PHASE,
Iowa Univ., Iowa City.
For primary bibliographic entry see Field 06E.
W70-04047

STABILITY OF SLOPES WITH SEEPAGE,
Colorado State Univ., Fort Collins. Natural Resources Center.
For primary bibliographic entry see Field 08D.
W70-04052

DELAWARE RIVER BASIN COMPACT.
For primary bibliographic entry see Field 06B.
W70-04081

FLOOD PLAIN INFORMATION, ARKANSAS RIVER AND TRIBUTARIES, PULASKI COUNTY, ARKANSAS, PART 1.
Corps of Engineers, Little Rock, Ark.

Prepared for Pulaski County, Ark. Corps Engineers Flood Plain Report, Nov 1969. 45 p, 16 fig, 27 plate, 12 tab.

Descriptors: *Floods, *Flood damage, *Arkansas, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: *Arkansas River, Pulaski County (Ark), Standard project flood, Intermediate regional flood

Flooding of the Arkansas River, Pulaski County, Arkansas is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-04094

FLOOD PLAIN INFORMATION - COASTAL FLOODING OF VIRGINIA BEACH, VIRGINIA.
Corps of Engineers, Norfolk, Va.

Prepared for the city of Virginia Beach. Corps Engineers Flood Plain Report, July 1969. 59 p, 11 fig, 10 plate, 3 tab.

Descriptors: *Floods, *Flood damage, *Virginia, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: *Virginia Beach (Va), Standard project flood, Intermediate regional flood.

Flooding in Virginia Beach, Virginia is described in a report of flood problems based on records of tides, storms, rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-04095

FLOOD PLAIN INFORMATION, SALADO CREEK, SAN ANTONIO, TEXAS.
Corps of Engineers, Fort Worth, Tex.

Prepared for the San Antonio River Authority. Corps Engineers Flood Plain Report, Oct 1969. 45 p, 6 fig, 28 plate, 13 tab.

Descriptors: *Floods, *Flood damage, *Texas, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: *San Antonio (Tex), Standard project flood, Intermediate regional flood.

Flooding of Salado Creek, San Antonio, Texas is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-04100

WISCONSIN'S FLOOD PLAIN MANAGEMENT PROGRAM.
Wisconsin Dept. of Resource Development, Madison.

Madison: State of Wisconsin, Department of Natural Resources, Nov 1967. 29 p.

Descriptors: *Wisconsin, *Management, *Flood plains, *Regulation, Flood control, Flood protection, Flood forecasting, Flood damage, Flood plain insurance, Flood plain zoning, Floodways, Non-structural alternatives, Floods, Floodproofing.
Identifiers: *Flood plain management.

This flood plain management program consists basically of three parts: (1) evaluation of the flood-

ng potential and identification of the flood plains by using criteria established herein by the Division of Resource Development, (2) formulation, administration and enforcement of reasonable regulations and other flood plain management practices which are based on sound technical data and consistent with state criteria and comprehensive community land use needs, and (3) continuous review and upgrading of flood plain management criteria and regulations based on new hydrologic, hydraulic and other technical information and methods. In addition to a statement of policies and procedures, a number of criteria used to evaluate flood plain regulations. Criteria applying to the following aspects of flood plain regulation were discussed: purposes and objectives, regional flood, flood plain delineation, floodway determination and delineation, regulatory flood protection elevations, floodway encroachments, areas between floodway or encroachment limits and levees, areas landward of floodway or encroachment limits, flood proofing measures, flood protective or control works, modifications or additions to existing structures, removal of designated flood plain limits, certifications of compliance and public information. (Davis-Chicago)
W70-04169

FLOOD-HAZARD MAPPING IN METROPOLITAN CHICAGO,
John R. Sheaffer, Davis W. Ellis, and Andrew H. Spieker.
Available free from the US Geological Survey, Wash, DC, 20242. US Department of the Interior, US Geological Survey, USGS Circular 601-C, 1970. 14 p, 6 fig, 2 tab, 10 ref.

Descriptors: *Cities, *City planning, *Flood plains, *Land use, Storm runoff, Utilities, Urbanization, Flooding, Flood plain insurance, Flood plain zoning, Floodproofing, Floods, Floodways, Flood forecasting, Land management, Land classification, Public lands.
Identifiers: *Chicago, *Flood plain information, *Flood-hazard mapping, *Flood plain management, Crest-stage gaging network.

The effective management of flood plains consists of more than building detention reservoirs and levees. As urban pressures are forcing more and more developments on flood plains, such devices as flood-plain regulations and floodproofing are coming into wider use. These devices require information as to what areas are likely to be flooded. Flood-hazard mapping is such a means of providing flood plain information for planning and management programs. Proper use of flood-hazard mapping will help to: (1) prevent improper land development in flood plain areas; (2) restrict uses that would be hazardous to health and welfare and which would lead to undue claims upon public agencies for remedy; (3) encourage adequate stream channel cross-section maintenance; (4) protect prospective home buyers from locating in flood-prone areas; (5) preserve potential for natural groundwater recharge during flood events; (6) guide the purchase of public open space; and (7) avoid water pollution resulting from the flooding of sewage treatment plants and solid waste disposal sites that were located on flood plains. The implementation of the flood-hazard mapping program in the Chicago area, including the establishment of a crest-stage gaging network is discussed. Examples of the usefulness of flood-hazard maps in urban development are presented, including regulation of private development, purchase of property for public use, development of public facilities and planning guidelines for future development. (Davis-Chicago)
W70-04170

GEORGIA WATER LAW (NAVIGABLE STREAMS, TIDEWATERS),
For primary bibliographic entry see Field 06E.
W70-04204

GEORGIA WATER LAW (DIFFUSED SURFACE WATERS),
For primary bibliographic entry see Field 06E.
W70-04206

GEORGIA WATER LAW (ADMINISTRATIVE STRUCTURE OF WATER USE AND WATER COURSES REGULATION),
For primary bibliographic entry see Field 06E.
W70-04209

WISE USE OF FLOOD PLAINS.

Wise Use of Flood Plains, New England River Basins Comm'n, p 1-34, July 1969. 34 p.

Descriptors: *New England, *Flood protection, *River basin development, *Flood control, Flood plains, Channel improvement, Dams, Flood forecasting, Floodproofing, Levees, Warning systems, Historic flood, Flood plain zoning, Rivers, Streams, Floods, Legislation, State governments, Administration, Federal government, Planning, Permits, Legal aspects.

A general survey is made of the reasons for flood damage to property and the results of previous attempts to lessen this damage. A summary is given of measures presently being employed by state governments to prevent flood damage and soften the effects of injuries which are not preventable. Methods of flood control are divided into preventive and corrective measures. State programs in Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont are described, together with federal programs for flood control. Particular emphasis is placed upon the Report of the Task Force on Federal Flood Control Policy of 1966. The study concludes with recommendations to the federal and state governments of means by which flood losses may be reduced throughout the United States. The recommendations discourage the development of property in areas susceptible to flooding. (See also W70-04214 thru W70-04217). (Dye-Florida)
W70-04213

WISE USE OF FLOOD PLAINS (FLOOD PLAINS).
Wise Use of Flood Plains, New England River Basin Comm'n, p 1-4, July 1969. 4 p.

Descriptors: *New England, *Flood plains, *Flood protection, *Flood damage, Flood control, Legal aspects, Dams, Flood forecasting, Floodproofing, Levees, River basin development, Warning systems, Water management (Applied), Flood plain insurance, Flood plain zoning, Streams, Floods.

Flood damage occurs when areas susceptible to flooding are developed for economic purposes. Though most such areas have had some historical flood problems, severe floods are infrequent and development eventually proceeds despite the danger of flood damage. The increasing urbanization and industrialization of society also contributes to development of areas along the seacoast and larger streams. Thus, despite heavy government expenditures for flood prevention and protection, yearly flood damage rises. The flood plain is a reserve area carved out by a watercourse to hold surplus water in times of flood. A simple solution to flood damage problems is to impede development of flood plains. Needs for railways, highways, hydro-electric plants, and dock facilities make this solution difficult to implement. A diagram shows methods of flood damage prevention, dividing them into corrective and preventive measures. Possible corrective measures include dams and reservoirs, levees, channel improvements, evacuation forecasting, and urban redevelopment. Preventive measures include zoning, building codes, development policies, warning signs, and insurance. (See W70-04213). (Dye-Florida)
W70-04214

WISE USE OF FLOOD PLAINS (STATE FLOOD CONTROL REGULATION).
Wise Use of Flood Plains, New England River Basin Comm'n, p 5-14, July 1969. 10 p.

Descriptors: *New England, *Flood plain zoning, *Flood control, *Flood protection, Legislation, Legal aspects, River basin development, Water management (Applied), Water policy, Flood plains, Rivers, Streams, Floods, State governments, Administration, Planning, Permits, Administrative agencies.

Following extremely severe flood damage in 1955, Connecticut enacted the Stream Encroachment Law which empowers a Water Resources Commission to establish enroachment lines along waterways and flood-prone areas. Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont have passed zoning enabling acts, allowing municipalities to zone flood plains for low-damage uses. Maine's executive agencies must consider potential flood damage in planning state-supported land development. Massachusetts has empowered the Department of Natural Resources to restrict urban development in areas of high flood danger; however, when a landowner objects to these restrictions on the development of his land, the Department must withdraw the restrictions or purchase the land. New Hampshire, New York, and Vermont are considering plans for flood control. Rhode Island has enacted zoning regulations which take into account the susceptibility of land to flooding. (See W70-04213). (Dye-Florida)
W70-04215

WISE USE OF FLOOD PLAINS (FEDERAL FLOOD CONTROL POLICY).
Wise Use of Flood Plains, New England River Basin Comm'n, p 14-29, July 1969. 16 p.

Descriptors: *Federal government, *Flood plains, *Flood control, *Administration, Administrative agencies, Project planning, Flood protection, Flood damage, Flood forecasting, Flood proofing, River basin development, Warning systems, Flood plain zoning, Floods, Legal aspects.

The Task Force on Federal Flood Control Policy was appointed to report on the causes of flood damage and applicable solutions. The Task Force recommended that the federal government undertake the following: (1) improvement of the knowledge of flood hazards, (2) coordination of plans for development of flood plains, (3) initiation of a program of technical information made available to flood plain managers, (4) creation of a national flood insurance plan, and (5) continued adjustment of federal flood control policy to changing needs. The Task Force made additional proposals for implementation of these major programs. The Corps of Engineers and the Soil Conservation Service should collect data on flood plains. Federally sponsored housing and assistance programs should consider the flood factor in their administration. An improved system for flood forecasting and warning should be devised. Land acquisition by government should become part of flood control policy. Federal assistance programs should be utilized to soften the effects of flood damage. (Dye-Florida)
W70-04216

WISE USE OF FLOOD PLAINS (RECOMMENDATIONS FOR WISE FLOOD PLAIN MANAGEMENT).
Wise Use of Flood Plains, New England River Basins Comm'n, p 30-34, July 1969. 5 p.

Descriptors: *Flood plains, *Administration, *Flood protection, *Flood plain zoning, Flood control, Federal government, State governments, Administrative agencies, Project planning, Flood damage, Flood forecasting, River basin development, Warning systems, Legal aspects, Cities.

Under existing laws in New England, towns and cities have the best opportunity to make wise use of

flood plains. State governments and the federal government can give some support. Each community should have a zoning code which implements its flood control policy. Each community, with the aid of federal agencies, should map areas subject to frequent flooding. Communities may condemn and purchase flood-prone lands, and federal grants may be available to aid in these purchases. Federal participation in flood plain management is limited to technical assistance to the state or local government. Each state should have a single office administering flood plain management. Executive orders should be issued to deter unwise flood plain development. State and local tax policies should encourage the continuance of present open or wetland areas. Flood forecasting and data collection should be emphasized. (Dye-Florida)
W70-04217

DRAINAGE DISTRICTS (GENERAL PROVISIONS).
Mo Ann Stat secs 242.010 thru 242.050 (1952), as amended, (Supp 1970).

Descriptors: *Missouri, *Drainage districts, *Drainage engineering, *Drainage programs, Legal aspects, Drainage systems, Administration, Legislation, Swamps, Wetlands, Land reclamation, Environmental sanitation, Sanitary engineering, Public health, Public benefits, Environmental engineering, Projects, Project planning, Programs, Agricultural engineering, Conservation.

The owners of a majority of the acreage in any contiguous body of swamp, wet or overflowed lands, or lands subject to overflow may form a drainage district to reclaim and protect the lands and other property from the effects of water, for sanitary or agricultural purposes, or for public convenience, health, welfare or benefit. The procedures in forming and organizing the drainage district are prescribed. The procedure for objecting to the formation of a drainage district by an owner of real estate or other property is set forth. The annexation of land to organize the drainage district is regulated. (Powell-Florida)
W70-04219

COOPERATION BY CITIES OF 100,000 INHABITANTS AND MORE WITH DRAINAGE DISTRICTS, ETC., FOR FLOOD PROTECTION.
For primary bibliographic entry see Field 03D.
W70-04230

NICHOLSON V HOLLOWAY PLANTING COMPANY (SERVITUDE OF DRAIN).
229 So 2d 679-697 (La 1969).

Descriptors: *Louisiana, *Water rights, *Drainage water, *Surface runoff, Judicial decisions, Legal aspects, Drainage practices, Surface waters, Water management (Applied), Easements, Preferences (Water rights), Riparian rights, Adjudication procedure, Overlying proprietor, Relative rights, Natural flow doctrine, Reasonable use, Obstruction to flow, Alteration of flow, Riparian land, Flow control, Watercourses (Legal).

Plaintiff's estate was adjacent to and north of defendant's estate. Both plantations fronted on the west side of a bayou. The predominant slope was from east to west from the bayou. Running across both properties are the remnants of numerous old crevasse channels, formed by the flood waters of the bayou. Plaintiff sought recognition of a servitude of drain in favor of his estate over defendant's adjoining property. The court held that plaintiff's estate was dominate; that channels naturally drained water from plaintiff's estate across defendant's estate; and that plaintiff's estate had a servitude of drain over defendant's estate. A controlling Louisiana Civil Code stated that lower land was legally obligated to receive surface waters which flow naturally through channels of natural origin from the adjoining dominant estate. But this included only such as would ordinarily run there in view of the land's configuration. The court also determined that a proprietor of an upper estate could make works tending to accelerate and hasten drainage of his own land beyond the natural slow process, but he could do nothing which would tend to throw upon the lower estate the burden of receiving waters which would not otherwise drain upon it. (Powell-Florida)
W70-04234

DRAINAGE DISTRICTS.
Mo Ann Stat secs 242.190, 242.210 (Legis Service No 1 1969).

Descriptors: *Missouri, *Drainage districts, *Administrative agencies, *Drainage, Legislation, Reclamation, Channel improvement, Reservoirs, Condemnation, Easements, Right-of-way, Bridges, Structures, Ditches, Levees, Land reclamation, Hydroelectric power, Hydroelectric plants, Construction, Maintenance, Electric power, Dams, Taxes, Assessments, Damages, Alteration of flow.

In order to effect the drainage, protection, and reclamation of property within the drainage district, the board of supervisors is authorized to: (1) clean out, straighten, widen, deepen, or change the course of flow of any ditch, drain, river, or watercourse; (2) fill up any creek, drain, channel, river, or watercourse; (3) concentrate, divert, or divide the flow of water in or out of the district; (4) construct and maintain ditches, canals, levees, dikes, dams, reservoirs, pumping stations and other needed improvements; and (5) construct all needed bridges, works, and improvements. The board is authorized to acquire and hold property and may condemn any needed land, easement, or right of way, reservoir, or holding basin. The board is empowered to control all water power created by the construction of works of the district and may construct and maintain hydroelectric power plants to develop such power. Any surplus power in excess of that required by the district may be leased. (Schram-Florida)
W70-04238

DRAINAGE DISTRICTS (BOARD OF SUPERVISORS).
Mo Ann Stat secs 242.060 thru 242.210 (1952), as amended, (Supp 1970).

Descriptors: *Missouri, *Administration, *Drainage districts, *Drainage engineering, Legislation, Drains, Drainage systems, Drainage programs, Legal aspects, Administrative agencies, Regulation, Hydroelectric plants, Water works, Condemnation, Construction, Maintenance, Water control, Operation and maintenance, Project planning, Electric power production.

The board of supervisors for a drainage district is authorized and empowered to clean out, widen, alter, or deepen any ditch, drain, lake, or watercourse in the district. The board is authorized to fill any creek, drain, channel or watercourse; concentrate, divert, or divide the flow of water in or out of the district; and construct and maintain main and lateral ditches, canals, levees, dikes, dams, sluices, revetments, reservoirs, holding basins, floodways, pumping stations, syphons, and any other improvements deemed necessary to preserve and maintain works inside or outside of the district. The board is empowered to construct or enlarge necessary bridges. The board may purchase or condemn any land, easement, railroad right-of-way, sluice, reservoir, holding basin, or franchise in carrying out its function. The board of supervisors may control all water power created by the construction of works in the district, and has the authority to construct and maintain hydroelectric power plants. (Powell-Florida)
W70-04242

DRAINAGE DISTRICTS (ORGANIZATION).
Mo Ann Stat secs 242.220 thru 242.300 (1952), as amended, (Supp 1970).

Descriptors: *Missouri, *Land reclamation, *Drainage districts, *Drainage engineering, Administration, Regulation, Legislation, Legal aspects, Levees, Drainage, Surface drainage, Drainage programs, Land management, Assessments, Projects, Project planning, Benefit sharing, Appraisals, Administrative agencies, Cost sharing, Cost-benefit theory, Damages.

The chief engineer of each drainage district is required to survey all lands within the district and all other lands which may be affected by improvements constructed in the district. The chief engineer's annual report is to be used as a basis for draining, leveeing, or reclaiming lands of the drainage district or preserving them from injury by overflow water. The circuit court may appoint commissioners to appraise lands to be acquired by the district for rights of way, holding basins, and other drainage works, and to assess benefits and damages accruing to district lands and other property by reason of planned land reclamation. The drainage district or any landowner in the district may file exceptions to the commissioners' report or to any assessment for either benefits or damages. (Powell-Florida)
W70-04245

DRAINAGE DISTRICTS (RECLAMATION).
Mo Ann Stat secs 242.310 thru 242.360 (1952), as amended, (Supp 1970).

Descriptors: *Missouri, *Drainage districts, *Administrative agencies, *Land reclamation, Drainage systems, Drainage programs, Drainage engineering, Compensation, Damages, Eminent domain, Contracts, Ditches, Levees, Canals, Government finance, Assessments, Construction, Bridge construction, Bridges, Highways, Excavation, Laterals, Embankments, Legislation, Legal aspects.
Identifiers: *Liens.

The board of supervisors of any drainage district may petition the circuit court to change the plan for reclamation of district lands, subject to challenge by the affected landowners. The court may appoint three commissioners to assess the damages and compensation to be paid to such landowners. The board is authorized to construct or contract for the construction of any works necessary to carry out the plan for reclamation. A chief engineer shall supervise all works and improvements. Enlargement of ditches or other improvements may be authorized by the board to remedy any inadequacies in the reclamation plan. Plans for all bridges to be constructed or enlarged under the plan must be approved by the chief engineer. Corporations may be required to construct or enlarge their own bridges. Landowners may construct bridges over any drainage structure. All drainage districts may install ditches across any highway provided the district builds a bridge across the ditch. (Dearing-Florida)
W70-04246

A CASE FOR THE SIMULTANEOUS APPLICATION OF DETERMINISTIC AND STOCHASTIC METHODS IN HYDROLOGY,
Manchester Coll. of Science and Technology (England).
J. B. White.
Proceedings of International Hydrology Symposium, Sept 6-8, 1967, Colorado State Univ, Fort Collins, Vol 1, Paper 74, p 595-599, 1967. 5 p.

Descriptors: *Streamflow forecasting, *Flood forecasting, *Statistical models, Stochastic processes, Discharge (Water), Unit hydrographs, Probability, Rainfall-runoff relationships, Runoff forecasting.
Identifiers: Watershed models.

The significance of deterministic models and stochastic variables (in the sense in which the terms are used in this paper) are outlined. Possible ways of combining stochastic and deterministic analyses are given for the ideal circumstances in which

deterministic knowledge would be completely accurate. It is then shown with the aid of illustrations concerning the extension of streamflow totals and the prediction of flood discharges that when deterministic knowledge is incomplete, the application of deterministic methods and of stochastic analysis in separate stages is inadequate. Instead the whole analysis must have a stochastic framework. (K-napp-USGS)
W70-04259

DRAINAGE DISTRICTS (CONNECTING SYSTEMS AND TAXATION).

Mo Ann Stat secs 242.370 thru 242.490 (1952), as amended, (Supp 1970).

Descriptors: *Missouri, *Drainage districts, *Drainage systems, *Taxes, Assessments, Government finance, Costs, Ditches, Drainage engineering, Drainage programs, Drains, Administrative agencies, Levees, Dikes, Compensation, Surveys, Land reclamation, Principal, Interest, Construction costs, Operation and maintenance, Legislation.
Identifiers: *Bonds.

All drainage systems already constructed in a newly organized drainage district may be connected and made part of the drainage plan of that district. Systems constructed after completion of the drainage plan may be connected with the district's drainage system only with the approval of the board of supervisors of the drainage district or upon petition in the circuit court. District overseers shall repair and maintain the drainage system within the district. The board may levy land taxes following a specified procedure to finance the organization, construction, and maintenance of the district. Taxes shall be levied in proportion to the benefits accruing to the lands. The board may issue bonds on the tax levies to be paid out of these taxes. (Dearing-Florida)
W70-04286

AN EVALUATION OF RANGE FLOODWATER SPREADERS,
Geological Survey, Denver, Colo. Water Resources Div.
For primary bibliographic entry see Field 03F.
W70-04324

SURFACE WATER RESOURCES OF SOUTH AFRICA,
University of the Witwatersrand, Johannesburg (South Africa). Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-04334

DELAWARE RIVER BASIN COMPACT (WATER SUPPLY, POLLUTION CONTROL, FLOOD PROTECTION).
For primary bibliographic entry see Field 06B.
W70-04359

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN ARIZONA.
Corps of Engineers, San Francisco, Calif. South Pacific Div.

U. S. Army Corps of Engineers, South Pacific Division, San Francisco, California, January 1969. 50 p, map.

Descriptors: *Planning, *Arizona, *Water resources development, *Flood control, Channel improvement, Multiple-purpose reservoirs, *Colorado River basin, Dams, Flood Plains, Recreation facilities, Semiarid climates, Arid lands.
Identifiers: *Gila River, Flood plain management, U.S. Army Corps of Engineers.

This publication contains current information on the Arizona water resources development program of the U.S. Army Corps of Engineers. The Corps' role in flood control and multiple-purpose reservoir projects is briefly outlined. Information is included on completed projects, as well as on projects in the investigation, planning, or construction stages. (Carr-Arizona)
W70-04387

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN CALIFORNIA.
Corps of Engineers, San Francisco, Calif. South Pacific Div.

U.S. Army Corps of Engineers, South Pacific Division, San Francisco, California, January 1969. 276 p, maps.

Descriptors: *Planning, *California, *Coastal engineering, *Multiple-purpose reservoirs, *Flood control, Navigation, Harbors, Shore protection, *Water resources development, Erosion control, Flood plains, Beach erosion, Recreation facilities, Semiarid climates.
Identifiers: *Debris control, Flood plain management, *U.S. Army Corps of Engineers.

This publication contains current information on the California water resources development program of the U.S. Army Corps of Engineers. The Corps' role in projects concerning beach erosion control, debris control, navigation, multiple purpose reservoirs, and flood control is briefly outlined. Information is included on completed projects, as well as on projects in the investigation, planning, or construction stages. Water resources development in arid and semiarid areas of California, as well as coastal areas, are discussed. (Carr-Arizona)
W70-04388

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN UTAH.
Corps of Engineers, San Francisco, Calif. South Pacific Div.

U.S. Army Corps of Engineers, South Pacific Division, San Francisco, California, January 1969. 32 p, maps.

Descriptors: *Planning, *Utah, *Flood control, *Multiple-purpose reservors, *Water resources development, Flood plains, Semiarid climates.
Identifiers: *Flood plain management, *U.S. Army Corps of Engineers.

This publication contains current information on the Utah water resources development program of the U.S. Army Corps of Engineers. The Corps' role in flood control, and multiple purpose reservoir projects is briefly outlined. Information is included on completed projects, as well as on projects in the investigation, planning, or construction stages. (Carr-Arizona)
W70-04393

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN NEVADA.
Corps of Engineers, San Francisco, Calif. South Pacific Div.

U.S. Army Corps of Engineers, South Pacific Division, San Francisco, California, January 1969. 38 p, maps.

Descriptors: *Planning, *Water resources development, *Nevada, *Flood control, *Colorado River basin, Multiple-purpose reservoirs, Semiarid climates, Flood plains, Recreation facilities.
Identifiers: *U.S. Army Corps of Engineers, Flood plain management.

This publication contains current information on the Nevada water resources development program of the U.S. Army Corps of Engineers. The Corps' role in flood control and multiple-purpose reservoir projects is briefly outlined. Information is included on completed projects, as well as on projects in the investigation, planning, or construction stages. (Carr-Arizona)
W70-04394

THE SEWERAGE AND DRAINAGE PROBLEM,
Department of Public Works, Chicago, Ill.
A. L. Tholin.
In: Environmental Engineering and Metropolitan Planning, edited by John A. Logan, Paul Opperman, and Norman E. Tucker, Evanston, Illinois: Northwestern University Press, 1963, p 91-109.

Descriptors: *Sewerage, *Drainage, *Urbanization, Conduits, Construction costs, Financing, Detention reservoirs, Gaging stations, Floodway, Floodproofing, Flood damage, Planning, Water pollution, Drainage systems, Public health, Sewage treatment.
Identifiers: *Combined sewers, *Sanitary sewers, *Storm sewers, Master plan, Sewer design, Metropolitan Sanitary District of Greater Chicago, Northeastern Illinois Planning Commission.

Recommendations are made regarding the sewerage and drainage problem. The desirable solution of the sewerage and drainage problem should include the following action: (1) convey spent water quickly by underground conduits to the place of treatment and disposal; (2) avoid combined sewers, if possible. Take a look at what they spill, and where; (3) design so as to conserve and utilize energy of flow to achieve economy of construction cost. There are many competing uses for public funds; (4) detain stormwater near the origin, where possible; next, in the neighborhood, or finally, in the valleys--but for the good of our pocketbooks and our downstream neighbors, hold all we can, as long as we can; (5) interpret river gagings with a critical eye. Estimate the effect of urbanization; (6) find out what flow-ways we need, establish and maintain them. If we can't afford to clear them all at once, try flood-proofing, and brace ourselves against damage; and (7) have a master plan. Included in the paper are: a formal comment, a discussion and a workshop regarding the subject matter. (Richard-Chicago)
W70-04431

A STORM DRAINAGE AND OPEN SPACE MASTER PLAN FOR HAMILTON COUNTY, OHIO,
Ralph G. Berk.
Hamilton County, Ohio Regional Planning Commission, Dec 1966. 77 p, 13 fig, 2 plate. HUD Urban Planning Project Ohio P-53.

Descriptors: *Drainage systems, Storm runoff, Sewers, Urbanization, Surface runoff, Floodproofing.
Identifiers: *Hamilton County, Ohio.

A planning study of Hamilton County, Ohio which provides a complete inventory and location of all streams, culverts, and bridges having drainage areas greater than 300 acres. Given are the complete physical characteristics of the drainage structures and the intervening reaches of their streams; a method is developed for determining flood flows. Flow quantities to be considered for design purposes are established, as well as indications for improvement of inadequate flows. The study provides accurate information about present and future flood hazards, their location and extent; about the erosion and siltation problems; and about open space needs. Provided are suggestions for subdivision regulations for the enabling and enforcing of protective measures. Supplied are guidelines for legislation necessary for carrying out any plans selected by decision makers. Suggestions for the financing and administering of public improvement programs are also made. (Starr-Chicago)
W70-04434

LEVEE DISTRICTS.

Ark Stat Ann secs 21-601 thru 21-653 (1968).

Descriptors: *Arkansas, *Levees, *Flood control, *Water districts, Legislation, Legal aspects, Engineering structures, Flood protection, Projects, Project planning, Civil engineering, Assessments, Land management, Administrative agencies, Administration.
Identifiers: *Levee districts.

Levee districts are created by the county court of the county containing lands subject to overflow. Consolidation of levee district boards is permitted with consent of the county courts involved whenever land in two or more counties is subject to overflow from the same crevasses or direction. Levee district boards may cooperate with any levee board of another state if necessary to complete their system of levees. Procedures for formation of the levee district and election of the directors of the levee board are enumerated. The board of directors has exclusive control and supervision of the levees in their district. The levee board determines what work must be done, what levees are to be constructed and protects the district from overflow. Procedures for assessment of lands subject to overflow and benefitted by the necessary work are enumerated. (Powell-Florida)
W70-04457

BIOLOGY OF THE CRAYFISH ORCONECTES CAUSEYI AND ITS USE FOR CONTROL OF AQUATIC WEEDS IN TROUT LAKES,
Bureau of Sport Fisheries and Wildlife, Washington, D.C.
For primary bibliographic entry see Field 02H.
W70-04500

4B. Groundwater Management

ECONOMICS OF GROUNDWATER DEVELOPMENT IN THE HIGH PLAINS OF COLORADO,
Colorado State Univ., Fort Collins. Natural Resources Center.
D. D. Rohdy.
Available from the Clearinghouse as PB-189 781, $3.00 in paper copy, $0.65 in microfiche. Colorado State Univ, Natural Resources Center, Completion Report, June 30, 1969. 7 p. OWRR Project B-007-COLO.

Descriptors: *Groundwater, *Development, *Linear programming, *Economic life, *Secondary effects, *Institutional structure, Farm adjustments, Aquifer, Water management, Legal problems.

Farmers using pump irrigation on the High Plains can make good returns from irrigating crops if they include sugar beets in the crop pattern and obtain high yields on all crops. High quality management is essential because average crop yields, or crop patterns without sugar beets, result in substantially lower net returns to management and labor. Irrigated agriculture on the High Plains can remain profitable for a minimum of approximately 40 years to a maximum of about 200 years depending on how fast the water is pumped from the underground aquifer. However, it should be pointed out that these estimates are based on current cost and return relationships. The secondary effects of groundwater development are the greatest on local agricultural trade and service sectors. The magnitude of these effects was estimated with an input-output study in one county on the High Plains. The income distribution effects of existing and alternative institutional arrangements for rationing water among competing users are examined for possible clues to reducing conflicts arising from the development and use of groundwater.
W70-04049

UNDERGROUND STORAGE OF IMPORTED WATER IN THE SAN GORGONIO PASS AREA, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
R. M. Bloyd, Jr.
Geological Survey Open-file report, July 30, 1969. 41 p, 10 fig, 7 tab, 21 ref.

Descriptors: *Water storage, *Artificial recharge, *California, Water yield, Discharge (Water), Interbasin transfers, Water resources development, Water management (Applied).
Identifiers: San Gorgonio Pass (Calif).

Estimated long-term average annual precipitation in the San Gorgonio Pass Water Agency drainage area is 332,000 acre-feet, and estimated average annual recoverable water is 24,000 acre-ft, or less than 10% of the total precipitation. Estimated average annual surface outflow is 1,700 acre-ft, and estimated average annual groundwater recharge is 22,000 acre-ft. Estimated subsurface outflow from the area in 1967 was 6,000 acre-ft into the Redlands area, 220 acre-ft into Potrero Canyon, and 800 acre-ft into the fault systems south of the Banning storage unit. An anticipated 17,000 acre-ft of water per year will be imported by 1980. Information developed in this study indicates it is technically feasible to store imported water in the eastern part of the Beaumont storage unit without causing adverse conditions and without losing any significant quantity of stored water. (Knapp-USGS)
W70-04102

ARTIFICIAL RECHARGE AND ITS POTENTIAL IN ILLINOIS,
Illinois State Water Survey, Urbana. Hydrology Section.
H. F. Smith.
Artificial Recharge and Management of Aquifers, Symposium of Haifa, Mar 19-26, 1967, International Association of Scientific Hydrology, Publication No 72, p 136-142, 1967. 7 p, 1 fig, 3 tab.

Descriptors: *Artificial recharge, *Water spreading, *Filtration, *Infiltration, *Illinois, Sands, Aquifers, Gravels, Pit recharge, Porous media, Filters, Turbidity, Temperature, Water quality.
Identifiers: Peoria (Ill).

A definite relationship is shown between the grain size of filter blankets and the amounts of sediment that penetrate the aquifer through recharge pits. High rates of recharge have been achieved under certain conditions where the filter grain size was optimum, the pit the correct shape, and the permeability high. Criteria established for evaluating the recharge potential of aquifers include thickness of aquifer, areal extent of aquifer, and minimum economical withdrawal rate, as well as limits of turbidity, temperature, and mineral and bacteriological quality of recharge water. These recharge criteria were applied to areas of Illinois where aquifers were known to exist. Estimates were made of the potential artificial recharge into surface sands and gravels of the state, particularly in northeastern Illinois where population is dense and where withdrawal exceeds natural and induced recharge. (Knapp-USGS)
W70-04119

ARTIFICIAL CONTROL OF STATIC FISSURE-KARST WATER RESOURCES IN CARBONATE ROCKS,
All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
N. I. Plotnikov.
Artificial Recharge and Management of Aquifers, Symposium of Haifa, Mar 19-26, 1967, International Association of Scientific Hydrology, Publication No 72, p 132-135, 1967. 4 p, 1 tab.

Descriptors: *Water storage, *Aquifers, *Artificial recharge, *Conjunctive use, *Limestones, Infiltration, Groundwater movement, Water yield, Induced infiltration, Surface-groundwater relationships, Permeability, Pumping, Runoff, Arid lands.
Identifiers: USSR.

Carbonate rocks are characterized by high recharge rates. Given the rock thickness required and an intermittent source of runoff, artificial recharge and static storage control of groundwater are feasible using dual-purpose water-supply wells. Water supply wells are constructed in contour well systems in river valleys at depths of 150 to 200 meters. Under the effect of the intensive groundwater pumping large cones of depression are formed around the water intakes. Favorable conditions are thus created for intensive recharge by floodwater and for the complete return of the static storage previously used. Operation practice of water-supply wells in the USSR in arid regions use constant well yields up to 100,000-150,000 cu m/day (Knapp-USGS)
W70-04120

THE STORAGE CAPACITY IN THE DUNE-WATER CATCHMENT AREA OF AMSTERDAM AND ITS EFFECT ON THE WATER QUALITY,
Municipal Waterworks of Amsterdam (Netherlands).
For primary bibliographic entry see Field 03B.
W70-04121

ARTIFICIAL RECHARGE OF WATER THROUGH WELLS: EXPERIENCE AND TECHNIQUES,
R. Sternau.
Artificial Recharge and Management of Aquifers, Symposium of Haifa, Mar 19-26, 1967, International Association of Scientific Hydrology, Publication No 72, p 91-100, 1967. 10 p, 10 fig.

Descriptors: *Artificial recharge, *Aquifers, *Limestones, *Injection wells, Hydrogeology, Water wells, Recharge wells, Groundwater management (Applied), Conjunctive use, Arid lands, Costs, Model studies.
Identifiers: *Israel, Well construction.

During recent years recharge operations were carried out in Israel in more than 100 wells. The amount of injected water totaled over 100 million cu m. In the wells of the limestone-dolomite aquifer the recharge rates reached over 2,000 cu m per hr and more during prolonged uninterrupted periods. The performance of the recharge wells are very satisfactory. Experience shows that it is unsuitable to recharge a well with free-falling water because air was sucked into wells during the process. When the inflow of water was stopped, air was released and burst out powerfully from the well casing, gathering water on its way. Where the limestone aquifer was directly overlain by layers of loose sand, the injected water rose up into the sand, and then dropped upon stoppage of injection, and subsidence of the ground occurred which caused complete loss of one well. Recommendations are made for adequate injection procedures and well construction. The choice of type of installation depends on the required hydrological benefits, and on type of operation (depending on whether a pause between injection and pumping is desired). The various techniques are compared and a proposal is made for a standardized installation to be used in wells for both pumping and recharging. (Knapp-USGS)
W70-04122

ARTIFICIAL RECHARGE THROUGH AUGMENTED BANK STORAGE,
Princeton Univ., N.J. Dept. of Civil and Geological Engineering.
R. J. M. De Wiest.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (Mar 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 53-68, 1967. 16 p, 6 fig, 10 ref.

Descriptors: *Artificial recharge, *Alluvium, *Groundwater basins, *New Jersey, Bank storage, Dams, Reservoirs, Floods, Streamflow, Surface-groundwater relationships, Unsteady flow.

entifiers: Princeton (NJ).

onsteady flow is examined for groundwater charge project in which rainfall runoff is returned a watertable aquifer in the vicinity of Princeton, J. The recharge is accomplished by damming a ver and its tributary and by reversing the hydrau- gradient between the river and its connected oundwater basin. Most of the natural recharge ccurs during the rainy season from November to te May. With the resulting buildup of the ground- ater level, effluent discharge to the rivers in- eases. This increase ultimately is a net loss of esh water to the ocean. This loss would be duced significantly by the construction of dams. ne increased water level in the rivers would auto- atically decrease the hydraulic gradient from the oundwater reservoir to the rivers and hence limit e effluent discharge. Simultaneously, the ground- ater reservoir would be pumped and this would ake available more storage space. (Knapp-SGS)
70-04125

EOLOGIC AND HYDROLOGIC FACTORS ELATED TO ARTIFICIAL RECHARGE OF HE CARBONATE-ROCK AQUIFER SYSTEM F CENTRAL ISRAEL,
eological Survey, Washington, D.C.
obert Schneider.
rtificial Recharge and Management of Aquifers, ymposium of Haifa (Mar 19-26, 1967), Interna- onal Association of Scientific Hydrology, Publica- on No 72, p 37-45, 1967. 9 p, 4 fig, 12 ref.

escriptors: *Artificial recharge, *Injection wells, Aquifers, Groundwater movement, Limestones, ater levels, Surveys, Hydrogeology, Data collec- ons, Aquifer characteristics, Geologic control, ratigraphy, Structural geology.
dentifiers: *Israel.

central Israel one of the main sources of ground- ater is a thick, highly permeable dolomite and mestone aquifer system known as the Cenomani- n-Turonian aquifer. Its porosity is mainly solution annels and cavities produced by faulting and olding. Owing to the scarcity of suitable surface eservoir sites, excess water is injected into the quifer for storage during the non-irrigation eason. One of the most important considerations planning artificial recharge is the selection of in- ction areas that are hydraulically remote from ischarge areas. The piezometric surface is very at but under natural conditions flow is generally estward and northwestward. Intensive pumping om about 1950 to the present has produced everal irregularly shaped shallow depressions. here are also several northeast trending 'hills' or idges' on the piezometric surface. The ridges ap- ear to coincide with downfaulted blocks or struc- ural basins, regarded as regions of relatively lower ermeability than adjacent regions of lower iezometric levels. As the piezometric depressions emote from the discharge areas are deepened by umping, they will become increasingly useful as orage areas for injected water. An ideal condition or an injection area is a well-defined piezometric epression with one or more piezometric 'ridges' etween it and the discharge area. (Knapp-USGS)
70-04126

HE SPREADING PATTERN OF INJECTED VATER IN A PERMEABILITY STRATIFIED QUIFER,
Vater Planning for Israel Ltd., Tel Aviv.
. Mercado.
rtificial Recharge and Management of Aquifers, ymposium of Haifa (Mar 19-26, 1967), Interna- onal Association of Scientific Hydrology, Publica- on No 72, p 23-36, 1967. 14 p, 6 fig, 1 tab, 13 ref.

escriptors: *Artificial recharge, *Dispersion, Aquifers, *Anisotropy, Diffusion, Groundwater ovement, Permeability, Transmissivity, Porosity, tratification, Surveys, Model studies, Water yield, ischarge (Water), Recharge, On-site tests, Injec- on wells.
dentifiers: *Israel.

An explanation is given of the existence of a transition zone between injected water and aquifer water, developed on the assumption of flow through a permeability horizontally stratified aquifer, in which the frequency of permeabilities follows approximately the normal distribution function. The resulting transition zone is 'S'-shaped, and similar to that caused by dispersion. Its shape depends on the permeability distribution factor. The width of the transition zone caused by the horizontally stratified flow is directly proportional to the distance travelled, while the width of the transition zone caused by dispersion is proportional to the square root of the distance travelled. The width of the dispersion transition zone increases during the return flow, whereas width decreases in the case of horizontally stratified return flow. It is believed that in nature the flows occur simultaneously and thus the shape and width of the transition zone is the resultant of the two processes. A field experiment of the 'injection-pumping pair' type carried out at the Haifa Bay Experimental Field is described and interpreted. The results of the investigations in the experimental field are applicable to large-scale underground recharge and mixing operations. (Knapp-USGS)
W70-04127

ELECTROMODELLING AS AN EFFECTIVE METHOD OF PROGNOSTICATING RESOURCES OF UNDERGROUND WATER DURING THEIR REPLENISHMENT,
For primary bibliographic entry see Field 07C.
W70-04128

GEORGIA WATER LAW (SUBTERRANEAN WATERS, PERCOLATING WATERS SUBTERRANEAN STREAMS, SPRINGS),
For primary bibliographic entry see Field 06E.
W70-04207

MOJAVE RIVER BASIN GROUNDWATER RECHARGE WITH PARTICULAR REFERENCE TO THE CALIFORNIA FLOODS OF JANUARY AND FEBRUARY 1969,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 02F.
W70-04323

EXPLOITATION TEST ON THE SUB-ALLUVIAL AND SUB-FLUVIAL MEUSE GROUNDWATER TO THE NORTH OF VERDUN (IN FRENCH),
J. Forkasiewicz, and M. Guillaume.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 143-158, 1967. 16 p, 9 fig, 2 tab.

Descriptors: *Water storage, *Artificial recharge, *Karst, *Limestones, Surface-groundwater relationships, Groundwater movement, Transmissivity, Permeability, Induced infiltration, Water levels, Water-level fluctuations.
Identifiers: *France, Verdun, Lorraine.

To provide for increasing water needs of France's North and Lorraine industrial areas, a plan is proposed to use Jurassic karstic limestones near Verdun for water storage. Winter high streamflow will be stored by recharge wells to supply summer withdrawal of 100,000 cu m/day without decreasing riverflow of alluvial water supplies. Pumping rates will be controlled by use of data from a network of monitor wells. Results of 5 years of field study including a 200-day pumping test are tabulated and shown graphically. (Knapp-USGS)
W70-04351

ARTIFICIAL RECHARGE BY INDUCED INTERAQUIFER LEAKAGE,
Geological Survey, Columbus, Ohio.
Morris Deutsch.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 159-172, 1967. 14 p, 11 fig, 1 photo, 2 tab, 5 ref.

Descriptors: *Artificial recharge, *Induced infiltration, *Michigan, *Aquifers, Glacial drift, Aquicludes, Recharge wells, Leakage, Sands, Gravels, Surface-groundwater relationships, Water spreading, Water storage.
Identifiers: *Kalamazoo (Mich), *Induced aquifer leakage.

The U. S. Geological Survey and the city of Kalamazoo, Michigan, conducted tests to demonstrate the feasibility of recharging an artesian glacial-drift aquifer by inducing leakage to it from a surficial sand aquifer. The surficial sand is under water-table conditions and in direct hydraulic connection with a creek draining it. Coefficients of leakage for the aquiclude ranged from 0.042 to 1.3 gpd/ sq ft/ft. The piezometric surface in the lower aquifer was higher than the water table in the upper sand, and leakage through the aquiclude was upward. Withdrawal of water from the lower aquifer reversed the direction of leakage, but sustained pumping would have resulted in objectionable declines in the piezometric surface and probable inflow of poor-quality water from below. Tests were run by pumping from the lower aquifer under different conditions of artificial recharge of the upper aquifer. Each test resulted in increased head differences between the upper and lower aquifers, which increased the rate of leakage and raised water levels in the lower aquifer. The rates of leakage were 1,600-1,900 gpm, respectively. After 6 years of pumping at the well field with artificial recharge, water levels have not declined appreciably. (Knapp-USGS)
W70-04352

RECHARGE AND WATER INJECTION IN UNDERGROUND AQUIFERS (IN FRENCH),
J. Tixeront, and J. M. Daniel.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 173-181, 1967. 9 p, 1 fig, 7 ref.

Descriptors: *Artificial recharge, *Water spreading, *Induced infiltration, *Permeability, *Infiltration, Groundwater movement, Arid lands, Sands, Silts, Clays, Water quality, Turbidity, Analog models, Resistance networks, Optimization, Discharge (Water), Water yield.
Identifiers: France, Clogging.

Thorough analysis of natural recharge conditions is essential to operate an artificial recharge plant. Water quality, particularly suspended load, is the main factor of the analysis. Drying of mud crusts after floods, and wind erosion during summer could explain the continuous recharge of arid zone aquifers in spite of alluvial deposition of mud on recharge areas during floods. The Oued Biskra, Algeria study gives an example of such a process and shows the smoothing of a discontinuous recharge into a continuous discharge through an underground reservoir. Moreover this example shows that artificial recharge can be induced by modifying the initial natural state by pumping. By means of an analog RC network it has been possible to find the optimal value of exploitable discharge of the system by computing the daily natural rate of recharge into the reservoir from observed variations of water level caused by flooding. (Knapp-USGS)
W70-04353

COMPARISON OF LABORATORY AND FIELD ANALYSES OF AQUIFER AND WELL CHARACTERISTICS AT AN ARTIFICIAL RECHARGE WELL SITE,
Geological Survey, Denver, Colo.; and Geological Survey, Little Rock, Ark.
For primary bibliographic entry see Field 02F.
W70-04354

ARTIFICIAL-RECHARGE EXPERIMENTS UTILIZING RENOVATED SEWAGE-PLANT EFFLUENT - A FEASIBILITY STUDY AT BAY PARK, NEW YORK, U.S.A.,
Geological Survey, Mineola, N.Y.
For primary bibliographic entry see Field 05D.
W70-04355

ARTIFICIAL RECHARGE FOR PUBLIC WATER SUPPLIES IN URBANIZED REGIONS,
Technische Hogeschool, Delft (Netherlands). Dept. of Sanitary Engineering.
For primary bibliographic entry see Field 05F.
W70-04356

HYDROGEOLOGICAL STRUCTURES AND WATER RESOURCE REGULARIZATION (IN FRENCH),
Gilbert Castany.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 413-425, 1967. 13 p, 9 fig, 2 tab, 13 ref.

Descriptors: *Water storage, *Regulation, *Reservoirs, *Artificial recharge, Hydrogeology, Aquifers, Injection wells, Water spreading, Forecasting.
Identifiers: France, Algeria, Tunisia.

Irregularity of surface water supplies and, to some extent, groundwater supplies, necessitates some form of water regulation reservoir use for efficient regional development. Surface reservoirs or groundwater recharge may be used. Examples are given of the use of groundwater reservoirs for regulation storage in France, Algeria, and Tunisia. To use underground storage, a thorough knowledge of the hydrogeology of the area is necessary. (Knapp-USGS)
W70-04360

ECONOMIC ASPECTS OF CONJUNCTIVE USE OF WATER, SMITH VALLEY, NEVADA, USA,
Nevada Bureau of Mines, Reno. Desert Research Inst.
Patrick A. Domenico.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 474-482, 1967. 9 p, 6 fig.

Descriptors: *Water resources development, *Conjunctive use, *Nevada, *Economics, Aquifers, Streams, Groundwater, Surface waters, Optimum development plans, Water management (Applied), Water supply.
Identifiers: *Smith Valley (Nev).

Supplemental irrigation wells in Smith Valley, Nevada, USA, are individually owned and operated and their use is permitted in conjunction with surface water for irrigation of about 6300 acres whereas an additional 8700 acres have surface-water rights only. Owing to the developed capacity of the wells, most conjunctive appropriators are virtually assured of a full supply of irrigation water every season regardless of the availability of surface water. Predicted on the basis of historic flow and well yield and assuming centralized control of the well fields for the benefit of the entire valley, the existing pumping facilities could provide about 93% assurance of a full supply of irrigation water for all appropriators. Thus, the problem reduces to one of a proper scale of operation. Analysis based on returns from ranching and cost of supplemental water for various levels of demand, efficiency, and lift, suggests that more groundwater could be pumped cheaper with the existing pumping facilities if the operation were centralized instead of under individual control. (Knapp-USGS)
W70-04363

MATHEMATICAL SIMULATIONS FOR BETTER AQUIFER MANAGEMENT,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 06A.
W70-04364

GROUNDWATER LEVELS IN NEW MEXICO, 1965, AND CHANGES IN WATER LEVELS, 1961-1965,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02F.
W70-04390

'ONE HUNDRED AND TWENTY-THREE FEET LONG': THE HORIZONTAL WELL AS A NEW METHOD OF RANGE WATER DEVELOPMENT,
Arizona Univ., Tucson. Cooperative Extension Service.
W. T. Welchert, and Barry N. Freeman.
Progressive Agriculture in Arizona, Vol 21, No 6, p 8-11, November-December 1969. 6 fig.

Descriptors: *Wells, *Stock water, *Range management, *Hydrogeology, *Perched water, *Drilling, Drilling equipment, Arizona, Arid lands, Logging (Recording).
Identifiers: *Horizontal wells, San Carlos Indian Reservation, Arizona.

The introduction of horizontal well drilling could revolutionize stock water development in Arizona and the West. Dirt tanks, trick tanks, and conventional wells are either unreliable, expensive, or require a great deal of maintenance. All of these problems are overcome with horizontal wells. The wells are 'cased springs' and require no power system to pump and dispense the water. This is due to the tapping of water trapped in dike formations or perched water tables. The drilling process and pumbing installation are both very simple. Total development cost for the well installations average $500.00 per site. Among the advantages of the horizontal wells are: very small water loss; low-cost maintenance; small initial investment; sanitary water supply; and greater chance of developing a successful well. (Carr-Arizona)
W70-04396

A WORLD GEOGRAPHY OF IRRIGATION,
For primary bibliographic entry see Field 03F.
W70-04404

KHARGA, FROM THE OASIS MAGNA TO THE NEW VALLEY (IN GERMAN),
For primary bibliographic entry see Field 03F.
W70-04412

WELLS AND WASTES.

Va Code Ann secs 45.1-131, 45.1-136 (1967).

Descriptors: *Virginia, *Wells, *Water sources, *Oil reservoirs, Legislation, Well casings, Drilling, Subsurface waters, Oil wells, Water wells, Drill holes, Groundwater, Springs, Water supply, Municipal water, Water works, Oil, Natural gas, Subsurface drainage, Water pollution sources.

An unproductive gas or oil well may be developed as a source of water upon the request of the owner of the well property. The driller should be paid a reasonable sum by the person desiring a water well for the casing and tubing left in the well. Oil may not be stored or accumulated where it may seep into openings in the bedrock, springs or water wells, or into the public water supply. (Douberley-Florida)
W70-04471

4C. Effects on Water of Man's Non-Water Activities

RUNOFF FROM FOREST AND AGRICULTURAL WATERSHEDS,
Colorado State Univ., Fort Collins. Natural Resources Center.
For primary bibliographic entry see Field 02A
W70-04055

STORM RUNOFF FROM FORESTED CATCHMENTS BY SUBSURFACE ROUTES,
Forest Service (USDA), Columbus, Ohio. Northeastern Forest Experiment Station
For primary bibliographic entry see Field 02G.
W70-04065

PRELIMINARY DETERMINATIONS OF HYDROBIOLOGICAL CONDITIONS IN THE VICINITY OF THE PROPOSED JETPORT AND OTHER AIRPORTS IN SOUTH FLORIDA, JULY 1969,
Geological Survey, Tallahassee, Fla.
Benjamin F. McPherson.
Geological Survey Open-file Report, Feb 1970. 31 p, 2 fig, 11 tab, 4 ref, append.

Descriptors: *Water quality, *Swamps, *National parks, *Florida, *Airports, Surveys, Wetlands, Aquatic environment, Water pollution effects, Aquatic habitats, Urbanization, Conservation.
Identifiers: Everglades, Everglades National Park.

Because of concern over the possible hazards posed by the Miami Jetport for Everglades National Park and the surrounding environment of south Florida, water quality data were collected before its opening. As Everglades National Park depends on a certain seasonal flow of unpolluted water, knowledge of the flow and quality conditions are needed so that any development to the north be designed to avoid causing ecological damage. Before any assessment of biological or water-quality changes can be made, pre-flight conditions must be known. Twenty-two stations were selected and sampled in April and July 1969. Three of these were at canals near existing commercial airports farther east. The remaining stations were located within a 30-mile radius of the Jetport. This report gives the results from the samples collected in July. (Knapp-USGS)
W70-04078

METROPOLITAN AREA DEFINITION: A RE-EVALUATION OF CONCEPT AND STATISTICAL PRACTICE,
Chicago Univ., Ill. Dept. of Geography.
For primary bibliographic entry see Field 06B.
W70-04171

GALVESTON BAY: TEST CASE OF AN ESTUARY IN CRISIS,
For primary bibliographic entry see Field 05C.
W70-04432

AN APPRAISAL OF A LAKE MICHIGAN SITE FOR CHICAGO'S THIRD AIRPORT.
Department of Public Works, Chicago, Ill.

Harza Engineering Co., Chicago, Ill., 1967. 49 p, 1 map, 5 fig, 2 photo, 1 append, 3 tab.

Descriptors: *Airports, *Lake Michigan, Dikes, Economic feasibility, Wave pile-up, Sand bars, Water quality, Sediment distribution, Cost comparisons, Access routes.
Identifiers: *Engineering feasibility, Polders.

The preliminary findings of five major categories of planning studies are presented in this report: (1)

establishment of basic requirements; (2) preliminary project design; (3) site investigations; (4) construction materials, methods and schedules ; and (5) estimate of cost. Consultants to the City of Chicago in the process of establishing the requirements for aviation, environment and navigation included: (1) Landrum and Brown, aviation consultants; (2) the Federal Aviation Agency; (3) the Federal Water Pollution Control Administration; (4) the Corps of Engineers; and the U.S. Army-Chicago District. The preliminary findings indicate that the development of an airport site in Lake Michigan is technically feasible. The costs estimates, prepared on the basis of a four year construction period, indicate that the construction cost will be about $247 to $284 million. This estimate is based on a site centered 5 1/2 miles east of Lake Shore Drive at 31st Street. Estimates are also given for three other locations and for an airport area larger than the one detailed in this report. (See also W70-04440 thru W70-04443). (Starr-Chicago)
W70-04439

CHAPTER 2: DESCRIPTION.
Department of Public Works, Chicago, Ill.

In: An Appraisal of a Lake Michigan Site for Chicago's Third Major Airport, Harza Engineering Co., Chicago, Ill., 1967. p 4-8.

Descriptors: *Airports, *Lake Michigan, Dikes, Access routes, Locating.
Identifiers: *Engineering feasibility, Polders.

For the purpose of this report, it has been assumed that the lake airport site would be circular in plan and have a diameter four miles enclosing 8,000 acres and would be located between 12th Street and 45th Street with two approaches: (1) a causeway and bridge from the Stevenson Expressway; and (2) a tunnel from 31st Street. The definite designs presented here are for the purpose of cost estimation, determination of feasibility, and evaluation of construction materials, methods and schedules; the final location will depend upon the recommendations of the FAA and the city's aviation consultants. The dominating element in the Lake Michigan Airport will be the enclosure dike; the height will vary from 50 to 80 feet and its dumping silty or clayey sands in the central part of the embankment. Sanitary sewage and runoff from the surfaced airport area will be collected separately without pollution of the lake in a detention pond with a minimum surface area of approximately 200 acres and an additional area reserved for water storage during precipitation periods. (See also W70-04439). (Starr-Chicago)
W70-04440

CHAPTER 4: CONSTRUCTION.
Department of Public Works, Chicago, Ill.

In: An Appraisal of a Lake Michigan Site for Chicago's Third Major Airport, Harza Engineering Co., Chicago, Ill., 1967. p. 24-36, 1 tab.

Descriptors: *Airports, *Lake Michigan, *Economic feasibility, Time.
Identifiers: *Engineering feasibility.

Considered in this chapter are the questions of construction feasibility and time. The results of surveys carried out to find the answers to these questions are presented. The purpose of these surveys was to determine: (1) if sufficient materials are available within practical distances and (2) the cost of obtaining, transporting and placing the materials. Future studies will attempt to define specific areas from which materials can be obtained and transported at minimum cost. Maps prepared by the Illinois Geological Survey indicate that there are many areas in northeastern Illinois with sizeable sand and gravel deposits. A side benefit that could be obtained from the use of Illinois resources is the possibility of forming large recreational lakes. The methods used to construct the lake airport will influence the project design, cost and construction time. Research will be done into special handling methods; but an assumption has been made during this appraisal phase that conventional equipment and construction methods would be used. (See W70-04439). (Starr-Chicago)
W70-04441

CHAPTER 5: COST.
Department of Public Works, Chicago, Ill.

In: An Appraisal of a Lake Michigan Site for Chicago's Third Major Airport, Harza Engineering Co., Chicago, Ill., 1967. p 37-42, 3 tab.

Descriptors: *Airports, *Lake Michigan, *Economic feasibility, Location, Access routes, Cost comparison.
Identifiers: *Engineering feasibility.

The total construction cost of this plan for the lake airport is estimated to be in the range of $247 to $284 million. A description is given in this chapter as to how the costs were estimated, and the estimated costs at three alternative locations are also presented in table form. None of the information presently available indicates that movements of the site for distances up to three miles in a northerly or southerly direction, parallel to the shoreline would cause a significant change in cost. For a more easterly location farther out into the lake, the costs would increase inasmuch as more fill would be required for higher embankments, wave action would be more severe, and access facilities would have to be longer. An accompanying table indicates that the incremental cost per acre decreases rapidly with increasing airport size. (See W70-04439). (Starr-Chicago)
W70-04442

CHAPTER 6: FUTURE STUDIES.
Department of Public Works, Chicago, Ill.

In: An Appraisal of a Lake Michigan Site for Chicago's Third Major Airport, Harza Engineering Co., Chicago, Ill., 1967. p 43-49.

Descriptors: *Airports, *Lake Michigan, Project planning, Sand bars, Clay loam, Gravels, Sands, Dike, Access routes.
Identifiers: *Engineering feasibility.

Future planning for the Lake Michigan Airport will depend to a degree upon the recommendation of FAA and city aviation consultants in regard to the location and size of the airport. There are two broad categories of future planning investigations: (1) field work to map the lakebed in the project area, exploration of foundation conditions, inventory of available materials, and laboratory analyses of the resulting data; and (2) verification and refinement of project designs so as to focus on environmental effects of the lake project and on the dike and access designs. The study of environmental effects will be done by means of hydraulic model testing and the collection of additional field data to supplement existing information. A small-scale model of the airport vicinity will be built to study the effect of the airport upon lake currents. Additional data will be obtained by measuring actual current velocities in the lake and by taking samples of lake water for an analytical study of the water quality. (See W70-04439). (Starr-Chicago)
W70-04443

4D. Watershed Protection

SOIL CONSERVATION DISTRICTS.

Va Code Ann secs 21-1 thru 21-5 (1960).

Descriptors: *Virginia, *Soil conservation, *Agricultural engineering, *Erosion control, Legislation, Water conservation, Soil erosion, Sediment control, Runoff, Irrigation engineering, Drainage, Flood prevention, Dams, Channel improvement, Public health, Reservoirs, Soil contamination, Soil management, Soil stabilization, Multiple-purpose projects, Agriculture, Flood control, Terracing, Contours.

The policy of the legislature is to provide for the conservation of soil resources, for the control and prevention of soil erosion, for the prevention of floodwater and sediment damages, and for furthering agricultural phases of water conservation. In so doing, the legislature intends to preserve natural resources, control floods, prevent impairment of dams and reservoirs, maintain the navigability of rivers and harbors, preserve wildlife, protect public land, and promote the general health, safety, and welfare of the people. A detailed list of the conditions and consequences leading to this legislative determination is included. Among these are soil erosion in the form of destructive sedimentation, increased flooding, and deterioration of soil and crops caused by improper land-use practices. Appropriate corrective methods, including land-use reforms, soil conservation practices, and engineering improvements, are endorsed. A section of definitions is included. Cooperation among soil conservation districts and between these districts and state agencies is authorized and prescribed. (Schram-Florida)
W70-04221

DRAINAGE AND SOIL CONSERVATION.
Va Code Ann secs 21-53 thru 21-57, 21-59 thru 21-62, 21-65 (1960), as amended, (Supp 1968).

Descriptors: *Virginia, *Soil conservation, *Water conservation, *Administrative agencies, Legislation, Demonstration farms, Erosion control, Land resources, Drainage, Irrigation, Soil erosion, Flood prevention, Water districts, Damages, Structures, Agricultural engineering, Cultivation, Sediment control, Multiple-purpose projects, Soil investigations, Soil management, Fertilizers, Seeds, Farm equipment.
Identifiers: *Conservation districts.

Soil and water conservation districts are authorized to conduct surveys and research relating to: (1) the character of soil erosion and floodwater and sediment damages; (2) agricultural phases of the conservation, utilization, and disposal of water; and (3) the preventive and control measures and improvements needed. They may publish their findings, disseminate information, and conduct demonstrational projects. These districts are authorized to carry out preventive and control measures for flood prevention or agricultural water conservation. These activities may be carried out on state lands or other lands within the district with the consent of the owner. The districts may offer financial aid and cooperation to land occupiers to carry out the objectives of this act. The districts may make agricultural and engineering machinery, fertilizer, seeds, and other equipment available to land occupiers within the district to assist in the prevention and control of soil erosion and for flood prevention. The districts may construct, improve, operate, and maintain all necessary or convenient structures for the purpose of this act. They may develop comprehensive plans and programs for soil and water conservation and may acquire and administer water and soil conservation projects. For these purposes, they may operate as agencies of the state or of the United States. (Schram-Florida)
W70-04223

MISSOURI WATERSHED PROTECTION AND FLOOD PREVENTION LAW.

Mo Ann Stat secs 278.160 thru 278.300 (1963), as amended, (Supp 1970).

Descriptors: *Missouri, *Watershed management, *Flood control, *Water districts, Erosion control, Flood protection, Soil management, Legislation, Adjudication procedures, Administrative agencies, Administration, Taxes, Assessments, Financing, State governments, Federal government, Coordina-

tion, Recreation, Disposal, Agriculture, Sediment control, Drainage, Consolidation, Industries, Irrigation.

Subdistricts of soil and water conservation districts may be formed for purposes of: (1) carrying out watershed and flood prevention programs; (2) preventing floodwater and sediment damages; (3) furthering the conservation, development, utilization and disposal of water; (4) increasing recreation and industry development; and (5) developing agricultural water management, irrigation and drainage. This act provides for: (1) the prescription of subdistrict establishment procedures by the State Soil and Water Districts Commission; (2) feasibility studies, hearing and referendum procedures; (3) government of subdistricts by boards of soil and water conservation district supervisors; (4) subdistricts located in more than one district; (5) an initial organization tax and annual taxes; (6) consolidation of two or more subdistricts; (7) expansion of subdistricts; (8) cooperation with federal programs; (9) assessments; and (10) disestablishment of subdistricts and their subsequent control by the State Soil and Water Districts Commission. (Marsee-Florida)
W70-04232

DELAWARE RIVER BASIN COMPACT (WATERSHEDS, RECREATION, HYDROELECTRIC POWER, FINANCING, GENERAL PROVISIONS).
For primary bibliographic entry see Field 06B.
W70-04361

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

APPLICATION OF RADIOISOTOPE TECHNIQUES TO A CRITICAL WATER RESOURCES PROBLEM AREA - NAMELY NUTRITIONAL POLLUTION,
Oklahoma Univ., Norman. Dept. of Civil Engineering and Sanitary Science; and Arkansas Univ., Fayetteville. Dept. of Civil Engineering.
George W. Reid, Robert A. Gearheart, James M. Robertson, and Robert M. Sweazy.
Available from the Clearinghouse as PB-189 793, $3.00 in paper copy, $0.65 in microfiche. Oklahoma State University Water Resources Research Institute Project Completion Report, 1969. 14 p, 1 fig, 1 tab, 1 append. OWRR Proj No A-011-OKLA.

Descriptors: *Eutrophication, *Nutrients, *Phosphorus compounds, Algae, Phosphates, Nitrates, Sewage effluents, Tertiary treatment, Water pollution sources, Water pollution effects, Laboratory tests, Model studies, Radioactivity techniques, Tagging.
Identifiers: Nutrient requirements (Algae).

Minimal concentrations of nitrogen and phosphorus necessary for the growth of algae were studied. A radioactive phosphorus method was used as one of the parameters for biological mass produced and phosphorus uptake rate in alga culturing unit. All other necessary inorganic and organic nutrients, including vitamin B-12 and other growth metabolites, were supplied in excess to allow maximum algae reaction to the nitrogen and phosphorus. The relationship between nitrogen, phosphorus and algal growth is expressed by a multiple regression analysis procedure. A bacterial bloom occurs within the second or third day in contrast to the algae growth which usually requires 6 to 8 days. The soluble phosphate is taken up 80-90% in the first day. At a phosphate concentration of 0.10 mg/l, the algal bloom condition threshold is reached. Regardless of the nitrogen concentration, this narrow range of sensitivity to the phosphorus concentration demonstrates the problem in attempting to control nutritional pollution. (Knapp-USGS)
W70-04074

COMPOSITION OF INTERSTITIAL WATERS OF MARINE SEDIMENTS: TEMPERATURE OF SQUEEZING EFFECT,
Southern California Univ., Los Angeles.
For primary bibliographic entry see Field 02K.
W70-04075

CHEMISTRY OF NITROGEN AND PHOSPHORUS IN WATER,
For primary bibliographic entry see Field 05C.
W70-04080

THE CALCULATION OF THE ACUTE TOXICITY OF MIXTURES OF POISONS TO RAINBOW TROUT,
Water Pollution Research Lab., Stevenage (England).
V. M. Brown.
Water Research, Vol 2, p 723-733, 1968. 8 fig, 2 tab, 20 ref.

Descriptors: *Ammonia, *Phenols, *Copper, *Bioassay, Hydrogen ion concentration, Water chemistry, *Water analysis, *Analytical techniques, Alkalinity, Water pollution effects, Toxicity, Lethal limit, Laboratory tests.
Identifiers: *Zinc, *Cadmium, *Lead, *Nickel, *Hydrogen cyanide, *Pollutant mixtures.

The estimation of the acute toxicity to trout of mixtures of the common industrial pollutants ammonia, phenol, zinc, copper, cadmium, lead nickel, and hydrogen cyanide is described. This is done from a knowledge of the concentrations of these poisons and of the temperature, pH value, total hardness, bicarbonate alkalinity, total dissolved solids concentration, and dissolved-oxygen concentration of the dilution water. The toxicity of the mixture is taken to be the sum of the proportions of the acutely toxic concentration of each poison. The assumptions made in the use of this method are discussed along with its limitations, and the fact that in critical areas of study, such estimates can never be substitutes for the actual determination of the toxicity of a water by the use of fish is stressed. (Sjolseth and Katz-Washington)
W70-04156

U.S. GEOLOGICAL SURVEY WATER-QUALITY DATA IN THE WILLAMETTE BASIN, OREGON, 1910-64,
Geological Survey, Portland, Oreg.
For primary bibliographic entry see Field 02K.
W70-04261

NUTRIENTS AND OTHER FORMS OF POLLUTION,
Minnesota Dept. of Conservation. Waters Section.
For primary bibliographic entry see Field 05C.
W70-04267

KEYS TO WATER QUALITY INDICATIVE ORGANISMS (SOUTHEASTERN UNITED STATES),
Toronto Univ. (Ontario). Dept. of Zoology.
R. O. Brinkhurst.
US Dep of the Interior, Federal Water Pollution Control Administration, undated. 17 p, 14 fig, 6 ref.

Descriptors: *Oligochaetes, *Water quality, Fresh water, Great Lakes region, Habitats, Tubificids, Water pollution, Sludge worms.
Identifiers: *Taxonomic key, North America East of Rocky Mountains, Acolosomatidae, Naididae, Enchytraeidae, Lumbriculidae, Opistocystidae, Setae, Branchiobdellidae, Bifid crotchets.

In identifying the Oligochaeta, by making keys to the most important family, the Tubificidae, and proceeding directly to species without keying out the genera, it has become possible to identify specimens from simple whole-mounts. About half of the Tubificidae may be identified from immature specimens; mature specimens are required for the rest--mature specimens are usually present in any community. These worms are hermaphrodite, with no larval stages. Upon studying the serial sections and the worms placed in the proper genera, species can often be fitted into the key using only superficial characters recognizable in whole-mounts. Good results depend on proper preparation and examination of material and understanding the salient anatomical features used in the key. Method of preparation and preservation is given. Principal features are the several types of setae. Bifid crotchets are found in both dorsal and ventral bundles in Naididae, Tubificidae and Lumbriculidae. A generalized plan of genitalia of a tubificid is given. Descriptions of various families, listing the approximate number of species in freshwaters east of the Rocky Mountains, and their normal habitats may be of more immediate value than the formal key given. (Jones-Wisconsin)
W70-04281

INFLUENCE OF METHOD FOR REMOVAL OF SESTON ON THE DISSOLVED ORGANIC MATTER,
Washington Univ., St. Louis, Mo. Dept. of Botany.
For primary bibliographic entry see Field 07B.
W70-04285

THE NATIONAL ESTUARINE POLLUTION STUDY - VOLUME II.
Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 05C.
W70-04300

CHEMICAL AND RADIOCHEMICAL ANALYSES OF WATER FROM STREAMS, RESERVOIRS, WELLS, AND SPRINGS IN THE RULISON PROJECT AREA, GARFIELD AND MESA COUNTIES, COLORADO,
Geological Survey, Denver, Colo.
For primary bibliographic entry see Field 02K.
W70-04307

DEVELOPMENT OF A METHOD FOR THE TOTAL COUNT OF MARINE BACTERIA ON ALGAE,
McGill Univ., Montreal (Quebec). Dept. of Microbiology and Immunology; and New Brunswick Univ., Fredericton. Dept. of Biology.
E. C. S. Chan, and Elizabeth A. McManus.
Canadian Journal of Microbiology, Vol 13, p 295-301, 1967. 2 fig, 3 tab, 10 ref.

Descriptors: *Marine bacteria, *Algae, *Analysis, *Analytical techniques, Temperature, Piptides, Intertidal areas, Soil bacteria, Laboratory tests.
Identifiers: *Algae homogenization, *Bacteria count, Waring Blendor mortality, Cell wall, Hexosamine, Ascophyllum nodosum, Polysiphonia lanosa, Point Lepreau (Canada), New Brunswick (Canada), Servall Omni-Mixer homogenizer.

In an initial attempt to develop a technique for enumeration of bacteria on littoral algae, it was observed that homogenization of algal samples in the Waring Blendor resulted in mortality of marine bacteria samples, apparently due to singular susceptibility to manipulations. Further work on this lethal effect of blending showed two detrimental factors, heat and mechanical injury of the cells, were implicated: due to the increase in temperature during homogenization (temperatures slightly beyond 35C result in rapid bacterial killing) and the high speed rotation of the knife-blade assembly of the Waring Blendor. These findings resulted in a satisfactory technique for obtaining homogenates of marine materials to obtain total bacteria count

using a Servall Omni-Mixer homogenizer at eds of about 5000 revolutions per minute and nperature of homogenization not exceeding C. With this method, it was possible to make an ensive study of ecology of marine bacteria on ysiphonia lanosa and Ascophyllum nodosum, former alga growing epiphytically on Ascophyl-. (Jones-Wisconsin)
0-04365

ALYTICAL CHEMISTRY OF PLANT TRIENTS,
sconsin Univ., Madison. Water Chemistry Lab.
Fred Lee.
rophication: Causes, Consequences, Cor-tives. Printing and Publishing Office, National ademy of Sciences, Washington, D C, 1969. p -658. 3 fig, 3 tab, 22 ref.

scriptors: *Analytical techniques, *Aquatic eds, *Water analysis, *Sampling, Plant physiolo- Eutrophication, Data collection, Chemical lysis, Reliability, Water pollution, Water pollu- effects, Nitrogen, Phosphorus, Algae, trients, Water properties.
ntifiers: *Nutrient elements, Phosphorus ease, Sample preservation, Water dynamics, ter constituents, Analytical chemistry, Waste er effects, Lake Mendota (Wis), Black Earth eek (Wis).

rious steps must be taken to achieve rational nagement of water basins invaded or threatened noxious aquatic weeds. The first phase of an rophication study involves a decision on the thod, location, and frequency of sampling, and manner of sample preservation. Next, is the ection of methods of analyses appropriate to the uired accuracy of results. Finally, a critical luation of results obtained as to their general re-ility and statistical significance. Detailed infor-tion on sources, forms, and methods of analysis plicable to nitrogen and phosphorus are given. dition of mercuric chloride and freezing to -C, rather than the use of chloroform and drogen sulfate, is recommended for the preserva-n of nitrogen forms and phosphorus compounds stored water samples. A warning is given about ssibility phosphate loss due to sorption by glass plastic containers. (See Vol. 3, No. 10, Field 5C, 0-03975). (Wilde-Wisconsin)
0-04382

SIMPLE PIPETTE CONTROL FOR ISOLAT-G PLANKTONIC ALGAE,
ode Island Univ., Kingston. Graduate School of eanography.
nda J. Boleyn.
nadian Journal of Microbiology, Vol 13, p 1129-30, 1967. 1 fig, 4 ref.

scriptors: *Algae, *Analytical techniques, ankton, *Laboratory tests, *Isolation, *Control, thodology, Cultures, Testing, Capillary conduc-ty, Bacteria, Diatoms, Test procedures.
ntifiers: *Pipette, Unialgal, Nitzschia, Algae lation, Capillarity, Capillarity control device.

levice for simplifying the isolation of plankton or er small particles has been developed. It erates by controlling the capillarity of the fine-ped pipette routinely used for phytoplankton lation. The inward and outward flow of fluid y be controlled smoothly and completely. There a number of advantages in this device over the modified isolating pipette. A steady hand is easi-maintained since the hand guiding the pipette ed not control capillarity also. The operator is e to nudge and steer reluctant or adhering forms o the pipette, especially where long slender cells, ose forms, or chain-formers might easily cluster l occlude the tip. A pipette with an orifice of all or large size may be used, making it helpful to late large or peculiarly shaped cells. The explo-e nature of pipette delivery is lessened and bub-ng is prevented. Motile organisms may be fol-ved and caught readily. The entire procedure is hastened, diminishing danger of thermal shock, especially important for winter forms. Also the risk of producing appreciable salinity changes is minimized. (Jones-Wisconsin)
W70-04469

A WATER CORE PLANKTON SAMPLER,
South Dakota Cooperative Fishery Unit, Brookings.
Richard L. Applegate, Alfred C. Fox, and Victor J. Starostka.
Journal Fisheries Research Board of Canada, Vol 25, No 8, p 1741-1742, 1968. 1 fig.

Descriptors: *Cores, *Plankton, *Sampling, Population, Zooplankton, Ice, Columns, Depth, Ponds, Lakes, Seasonal Littoral.
Identifiers: Vertical sampling.

A rapid method for quantitative sampling of net plankton populations was provided by a device constructed from irrigation pipe. It was developed for collecting zooplankton under ice cover, when metered townets could not be conveniently used. Error associated with back-flushing when a plankton net is drawn through a vertical water column is eliminated, thus the quantity of net plankton can be determined accurately. Consisting of 152-millimeter-diameter aluminum pipe, the sampler is light weight, simple to operate, and economical. The hinged bottom section to which the net is attached, is held open by a line attached to the bucket. The net is brought into the filtering position by pulling the lazy-line after the sampler is lowered to the desired depth. As the sampler is raised and the column of water strained, the net is fixed in place by a spring latch. By adding or removing sections of pipe, the sampler can be adapted for any depth, making it a convenient tool for sampling net plankton populations in ponds and littoral areas of lakes throughout all seasons. (Jones-Wisconsin)
W70-04489

5B. Sources of Pollution

COMPUTER SIMULATION OF WASTE TRANSPORT IN GROUNDWATER AQUIFERS,
Colorado State Univ., Fort Collins. Natural Resources Center.
D. L. Reddell, and D. K. Sunada.
Available from the Clearinghouse as PB-189 769, $3.00 in paper copy, $0.65 in microfiche. Colorado State Univ, Natural Resources Center, Partial Completion Report, June 30, 1969. 13 p, 8 ref. OWRR A-001-COLO.

Descriptors: *Computer models, *Groundwater, *Dispersion, *Waste dilution, Water pollution sources, Numerical techniques, Saline water freshwater interfaces.

A computer simulation of the convective-dispersive process of the movement of pollutants in groundwater systems was developed and tested for several conditions. An implicit numerical technique was used to solve the flow equation and the method of characteristics used to solve the convective-dispersion equation. The model was tested by applying it to longitudinal dispersion problem and the longitudinal and lateral dispersion problem. The tensorial nature of the dispersion coefficient was demonstrated by solving a problem in the rotated coordinate system. The model was successfully used to solve the salt-water interface problem.
W70-04051

BOUNDARY EFFECTS ON JET FLOW PATTERNS RELATED TO WATER QUALITY AND POLLUTION PROBLEMS,
Illinois Univ., Urbana. Dept. of Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-04068

POTOMAC ESTUARY MATHEMATICAL MODEL,
Federal Water Pollution Control Administration, Annapolis, Md. Chesapeake Field Station.
Leo J. Hetling.
Water and Sewage Works, Vol 117, No 2, p 47-51, Feb 1970. 5 p, 7 fig, 8 ref.

Descriptors: *Systems analysis, *Mathematical models, *Estuaries, Water management (Applied), Research and development, Water quality, Water yield, Water supply, Flow, Path of pollutants, Water pollution control, Waste water treatment.
Identifiers: Potomac River, Potomac Estuary.

Publications concerning systems analyses and mathematical modeling of the Potomac Estuary are reviewed and discussed briefly. A systems analysis approach has been undertaken by the Federal Water Pollution Control Administration (FWPCA) in investigating the water quality responses in the Potomac River basin. The analyses included the effects of low flow augmentation, wastewater diversions, water supply withdrawals, and increased degrees of wastewater treatment on water quality in the upper estuary. Several techniques of mathematical models capable of simulating the response of water quality in an estuary were available when the study of the Potomac Estuary was undertaken in 1965. The segmented estuary model developed by Thomann was selected as the one which most closely conformed to the requirements of the study. The segmented model is highly flexible and capable of being utilized to describe almost any pollutant. Its accuracy is adequate for engineering design purposes. Properly programmed, the digital computer makes possible solutions of the systems available in minutes at a relatively small cost. (Knapp-USGS)
W70-04077

FRESHWATER ECOLOGICAL STUDIES IN PANAMA AND COLUMBIA,
Battelle Memorial Inst., Richland, Wash. Environmental and Life Sciences Div.
W. L. Templeton, J. M. Dean, D. G. Watson, and L. A. Rancitelli.
BioScience, Vol 19, No 9, p 804-808, 1969. 2 fig, 4 tab, 5 ref.

Descriptors: *Ecosystems, *Rivers, Chemical analysis, Fish, Crustaceans, Reptiles, Gastropods, Radiation, Nuclear engineering.
Identifiers: *Nuclear excavations, *Panama, *Colombia, *Radionuclides, Activation analysis, Specific activity, Concentration factors, Radiation dose, South America, Tissue analysis, Vegetation canopy.

Studies were made to acquire data for evaluation and prediction of potential radiation dose to indigenous populations in the region of proposed nuclear excavations. Freshwater rivers and streams supply water for domestic use and food in forms of fish, reptiles, and macroinvertebrates; in areas accessible to the sea, marine food organisms are preferred over freshwater forms. Daily consumption is estimated at 100 grams aquatic food and 4 liters water. Collections were made at 19 stations in Panama and 15 stations in Colombia; chemical and activation analyses were made of water, suspended solids, and tissue. Low concentrations of elements suggest high capacity for retention and cycling in terrestrial-soil ecosystem. Interflow predominates over sheet run-off. Water samples show relatively high concentrations of sodium, magnesium, cobalt, chromium, and cesium and low concentrations of potassium, iron, and antimony compared with mean values for all rivers. Concentration factors of stable elements vary with tissue analyzed, being highest for phosphorus, mercury, potassium, and copper. Contribution of direct fallout to freshwater ecosystem is likely to be small owing to vegetation canopy. Occurrence of peak concentrations will depend on rate of movement through terrestrial and groundwater systems; these should dampen the peaking effect. (Voigtlander-Wisconsin)
W70-04182

RELATIONSHIP BETWEEN BACTERIA, NUTRIENTS AND RAINFALL IN SELECTED BODIES OF FRESH WATER,
Florida Inst. of Tech., Melbourne. Univ. Center for Pollution Research.
For primary bibliographic entry see Field 02H.
W70-04189

POLLUTION AT THE SOUTHERN END OF LAKE MICHIGAN (WATER POLLUTION),
James C. Vaughn.
Am Water Wks Ass'n J, Vol 61, No 11, p 603-609, Nov 1969. 7 p, 1 ref.

Descriptors: *Water pollution, *Water quality control, *Water pollution sources, *Pollution abatement, Treatment facilities, Aquatic micro-biology, Impaired water quality, Pollutant identification, Water pollution treatment, Water pollution effects, Plankton, Aquatic bacteria, Direct costs, Effluents, Administration, Statistics, Sampling, Industrial wastes, Chemical wastes, Sewage treatment.
Identifiers: Treatment costs.

The Chicago-Southern Lake Michigan areas has a long history of battling water pollution. Various administrative boards--state, regional, and federal--have been formed to deal with the problem. Material presented at conferences of these boards reveals the scope of the pollution problem. Domestic sewage pollution has been somewhat alleviated, but data collected from the several sampling points in the Chicago metropolitan area and in Lake Michigan reveal that chemical and bacterial pollution is still a serious problem. Pollutants such as ammonia nitrogen, coliform organisms, plankton, phenol, and hydrocarbons are much in evidence as shown by several graphs and tables and the prevailing trend is toward more pollution. Rising pollution treatment costs have added to the difficulties. Industrial wastes are increasing, giving rise to the plankton pollution and offensive tastes and odors in the water. The article states that unless there is a quantitative reduction in these industrial wastes, there will be little chance to improve water quality. (Caldwell-Florida)
W70-04211

WATER POLLUTION BY NUTRIENTS-SOURCES, EFFECTS AND CONTROL, PAPERS PRESENTED AT 1966 ANNUAL MEETING OF MINNESOTA CHAPTER SOIL CONSERVATION SOCIETY OF AMERICA.
Minnesota Univ., Minneapolis. Water Resources Research Center.

Available from the Clearinghouse as PB-189 794, $3.00 in paper copy, $0.65 in microfiche. WRRC Bulletin 13, Minnesota Water Resources Research Center, June 1969. 79 p. OWRR Project A-999-MINN.

Descriptors: *Water pollution sources, *Water pollution effects, *Eutrophication, *Nutrients, Algae, Fish population, *Water pollution control, Farm wastes, Municipal wastes, Septic tanks, Recreation wastes, Water quality.
Identifiers: *Nutrient sources.

The Bulletin includes the papers presented at a conference on 'Nutrient Pollution - Sources, Effects and Control' held in Minneapolis, Minnesota on January 8, 1969. The conference was planned as the Annual Meeting of the Minnesota Chapter, Soil Conservation Society of America. The papers, all individually abstracted, include the following titles: Nutrients and Other Forms of Pollution, Diagnosing Pollution in Lake Minnetonka, Effect of Eutrophication on Fish and Related Organisms, Health Aspects, Surface and Groundwaters, Animal Waste Disposal Problems and Trends in Minnesota, Managing Livestock Wastes to Control Pollution, Runoff and Sediment as Nutrient Sources, Controlling Nutrients and Organic Toxicants in Runoff, Treatment of Municipal Wastes, Septic Tank Effluents, Water Pollution in Recreational Areas - Sources and Control, and Setting Water Quality Standards and Regulating Nutrient Sources, Implementing Pollution Control.
W70-04266

RUNOFF AND SEDIMENT AS NUTRIENT SOURCES,
Agricultural Research Service, Morris, Minn. North Central Soil Conservation Research Center.
For primary bibliographic entry see Field 05C.
W70-04272

CONTROLLING NUTRIENTS AND ORGANIC TOXICANTS IN RUNOFF,
Minnesota Univ., Minneapolis. Dept. of Soil Science.
For primary bibliographic entry see Field 05C.
W70-04273

SEPTIC TANK EFFLUENTS,
Minnesota Univ., Minneapolis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05C.
W70-04275

WATER POLLUTION IN RECREATIONAL AREAS--SOURCES AND CONTROL,
Forest Service (USDA), Ely, Minn. Superior National Forest.
For primary bibliographic entry see Field 05C.
W70-04276

THE NATIONAL ESTUARINE POLLUTION STUDY - VOLUME II.
Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 05C.
W70-04300

COMPUTER MODEL OF CONNECTICUT RIVER POLLUTION,
United Aircraft Corp., East Hartford, Conn. Research Labs.
Thomas E. Hoover, and Robert A. Arnoldi.
Journal Water Pollution Control Federation, Vol 42, No 2, Part 2, p R67-R75, Feb 1970. 9 p, 4 fig, 1 tab, 11 ref.

Descriptors: *Water pollution, *Rivers, *Computer models, *Connecticut, Mathematical models, Stochastic processes, Statistical methods, Path of pollutants, Water pollution treatment, Water pollution control, Biochemical oxygen demand, Sewage treatment, Thermal pollution, Dissolved oxygen.
Identifiers: Connecticut River.

A computer model designed to reproduce the physcial and chemical processes in the Connecticut River was used to predict the effects of wastewater disposal, aeration, and thermal pollution on the DO and BOD in the river. Actual chemical and physical input data used for the construction of the model were obtained from six independent sources. The DO and BOD concentrations were calculated for a simulation period of 48 hr and presented graphically as a function of time using a special contouring system developed for this study. After the capability of the model was proved by duplicating existing DO and BOD concentration levels in the river, the program was used to demonstrate that a reduction in the wastewater dumped into the river would produce a significant improvement in water quality, whereas aeration would produce only a minimal improvement. River modeling techniques using actual data may be useful in water quality management. (Knapp-USGS)
W70-04302

PARATHION DEGRADATION IN LAKE SEDIMENTS,
Wisconsin Univ., Madison. Dept. of Soil Science; and Texas Christian Univ., Fort Worth. Dept. of Geology.
Donald A. Graetz, Gordon Chesters, Tommy C. Daniel, Leo W. Newland, and Gerhard B. Lee.
Journal Water Pollution Control Federation, Vol 42, No 2, Part 2, p R76-R94, Feb 1970. 19 p, 7 fig, 4 tab, 18 ref. OWRR Grant No B-016-WIS, and FWPCA Training Grant No 5T1-WP-100.

Descriptors: *Biodegradation, *Organophosphorus pesticides, *Bottom sediments, Aerobic conditions, Anaerobic conditions, Chemcial reactions, Hydrolysis, Insecticides, Lakes.
Identifiers: Parathion degradation

Mechanisms and rates of parathion degradation were determined in a sterile sediment, in aerobic and anaerobic 1-percent peptone solutions, in a peptone-enriched sediment system, and intact sediments from two Wisconsin lakes. Chemical degradation involved hydrolysis at the nitrophenyl C-O-P bond resulting in the formation of diethylthiophosphoric acid and p-nitrophenol. The rate of parathion hydrolysis in an aqueous parathion solution containing sterile sediment was 0.15 to 0.18 percent of added parathion per day. Aminoparathion was degraded further under aerobic conditions but not under anaerobic conditions. Parathion degradation was slower in a slightly acid sediment than in a calcareous sediment. Rates of parathion degradation averaged 0.28 percent of added parathion per day in aqueous suspensions containing 90 and 200 mg Lake Tomahawk sediment compared with 0.54 and 0.74 percent of added parathion per day in suspensions containing 0.5 and 1.5 g Nagawicka sediment. (Knapp-USGS)
W70-04303

GROUNDWATER FLOW SIMULATED ON COMPUTER AIDS NUCLEAR PLANT RADIOACTIVE WASTE STUDY,
Battelle-Northwest, Richland, Wash. Water Resources Systems Section.
Robert T. Jaske.
Industrial Water Engineering, Vol 6, No 12, p 48-49, Dec 1969. 2 p 7 fig.

Descriptors: *Groundwater movement, *Mapping, *Flow nets, *Computer programs, Data processing, Forecasting, Water levels, Water table, Water level fluctuations, Computer models, Hydraulics.
Identifiers: Groundwater flow simulation.

In studying underground disposal systems for the Hanford nuclear plant, Battelle-Northwest developed a computer program which simulates the flow of groundwater. Flow patterns are displayed on a cathode-ray screen. Examples are given of the output of this program, showing the effect of adding additional points of withdrawal and injection to the original flow pattern. These changes are produced in a matter of seconds. (Knapp-USGS)
W70-04309

BEHAVIOR AND REACTIONS OF COPPER SULFATE IN AN IRRIGATION CANAL,
Battelle Memorial Inst., Richland, Wash; and Agricultural Research Service, Prosser, Wash. Crops Research Div.
J. L. Nelson, V. F. Bruns, C. C. Coutant, and B. L. Carlile.
Pesticides Monitoring Journal, Vol 3, No 3, p 186-189, Dec 1969. 4 p, 2 tab, 6 ref.

Descriptors: *Pesticides, *Algicides, *Irrigation canals, *Copper sulfate, Water chemistry, Sorption, Ion exchange, Pesticide residues, Pesticide kinetics, Persistence, Leaching, Infiltration.
Identifiers: Sunnyside (Wash).

Measurements of copper concentrations in water, in suspended sediment, and in bottom sediment of an irrigation canal after a copper sulfate treatment at 1 lb/cfs indicate that, after dissolution, much of the copper is sorbed by suspended sediment which gradually settles to the canal bottom. A large part of the copper in the deposited sediment is then slowly fed back into the canal water over a period of many hours. Buildup of copper in irrigated soils appears to be very minor. (Knapp-USGS)
W70-04315

THE SPREAD OF OIL SLICKS ON A CALM SEA,
Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.
James A. Fay.
Available from Clearinghouse as AD-696 876, $3.00 in paper copy, $0.65 in microfiche. Massachusetts Institute of Technology Fluid Mechanics Laboratory Publication No 69-6, Aug 1969. 14 p, 3 fig, 2 ref.

Descriptors: *Oily water, *Oil-water interfaces, *Mathematical studies, Water pollution effects, Oil wastes, Water pollution sources, Hydraulics, Physical properties.
Identifiers: Oil-slick spreading.

The spread of oil slicks on water is analyzed mathematically and compared with field observations. Observations almost always show a rapid spread to a size which increases with volume of the spill, followed by a long period of no further growth. This behavior is ascribed to a sudden reduction of the net surface tension at a time when evaporation and dissolving of the lighter components of the oil has occurred. (Knapp-USGS)
W70-04321

ACID MINE DRAINAGE IN APPALACHIA.
Appalachian Regional Commission, Washington, D.C.
For primary bibliographic entry see Field 05G.
W70-04328

THE INCIDENCE AND FORMATION OF MINE DRAINAGE POLLUTION IN APPALACHIA.
Corps of Engineers, Cincinnati, Ohio. Office of Appalachian Studies; and Bureau of Mines, Pittsburgh, Pa.
For primary bibliographic entry see Field 05G.
W70-04331

AUTOMATIC WATER SAMPLING PROPORTIONAL TO STREAMFLOW,
Geological Survey, Washington, D.C.; and Oak Ridge National Lab., Tenn. Instrumentation and Controls Div.
P. H. Carrigan, Jr., and W. F. Johnson.
Available from Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $3.75 per copy. Geological Survey Research 1969, Professional Paper 650-D, p D278-D282, 1969. 5 p, 5 fig, 2 ref.

Descriptors: *Water quality, *Sampling, *Monitoring, *Automatic control, Automation, Instrumentation, Radioisotopes, Radioactive wastes, Flowmeters, Waste dilution, Tracking techniques, Tracers, Dye releases.
Identifiers: Oak Ridge (Tenn), Automatic water sampling.

Low-level radioactive wastes from the Oak Ridge National Laboratory are released to the Clinch River, 2.3 miles downstream from Melton Hill Dam. Water samples proportional to river flow are composited at two stations, immediately and 8.6 miles downstream from the dam, to monitor radioactivity in the river. Sampling at the stations responds immediately to rapid changes in waste dilution owing to power releases at the dam. The sampling equipment frequently diverts aliquots of river water into a container, the duration of diversion being proportional to river flow. The flow is measured by the turbine flowmeter in the dam powerhouse and by a vane-deflection meter, developed in this study, at the respective stations. (Knapp-USGS)
W70-04336

EFFECT OF INDUSTRIAL EFFLUENT ON WATER QUALITY OF LITTLE SIX MILE CREEK NEAR JACKSONVILLE, FLORIDA,
Geological Survey, Ocala, Fla.
For primary bibliographic entry see Field 05C.
W70-04344

BRIEF TO THE INTERNATIONAL JOINT COMMISSION CONCERNING THE POLLUTION OF LAKES ERIE, ONTARIO AND THE INTERNATIONAL WATERS OF THE ST LAWRENCE RIVER,
Toronto Univ. (Ontario). Great Lakes Inst.
For primary bibliographic entry see Field 05G.
W70-04378

ANALOG COMPUTER MODELS FOR MOVEMENT OF NUCLIDES THROUGH ECOSYSTEMS,
Oak Ridge National Lab., Tenn. Health Physics Div.
Jerry S. Olson.
Radioecology, Vincent Schultz and Alfred W. Klement, Jr, editors, Reinhold Publishing Corp, N Y and The American Institute of Biological Sciences, Washington, D C, 1963. p 121-125. 9 fig, 9 ref.

Descriptors: *Analog models, *Analog computers, *Ecosystems, *Simulation analysis, *Computer models, Radioecology.
Identifiers: *Analog computer simulation, *Ecosystem modeling, Radionuclide movement.

Analog computers should fulfill an increasing need in the interpretation of radioecology data by providing a physical simulation of ecosystem processes. Such simulation capability offers a valuable analytic tool for resolving complicated ecological systems into their basic components. Construction of analog computer networks from ecosystem compartment models is accomplished through use of integrators, feedback potentiometers, function generators, servomultipliers, and diode-limiters. Diagrams of a simple ecosystem compartment model and its analog computer counterpart demonstrate the conversion technique. The analog computer models are as effective with nonlinear ecosystem models as they are with highly simplified linear models, thus they have advantages over other simulation tools. Analog models have been used to study transfer of carbon and radioactive carbon-14 in the ecosystem, and the same methodology can be extended to produce a variety of models for studying the transfer of fission products and mineral nutrients through ecosystems. (See Vol. 2, No. 19, Field 5C, W69-07863). (Huff-Wisconsin)
W70-04380

THE GREAT AND DIRTY LAKES,
For primary bibliographic entry see Field 05G.
W70-04430

ROSTHERNE MERE, ENGLAND, A FURTHER INSTANCE OF GUANOTROPHY,
Liverpool Univ. (England). Dept. of Zoology.
Ralph O. Brinkhurst, and Brenda Walsh.
Journal Fisheries Research Board of Canada, Vol 24, No 6, p 1299-1313, 1967. 4 fig, 1 tab, 24 ref, appendix.

Descriptors: *Water pollution sources, *Birds, Eutrophication, Benthic fauna, Sediments, Copepods, Organic matter, Pollutant identification, Hydrogen sulfide, Sampling, Chemical analysis, Nitrates, Phosphates, Temperature, Oxygen, Depth, Physicochemical properties, Tubificids, Ammonia, Diptera, Surface waters, Phytoplankton, Cyanophyta.
Identifiers: *Rostherne Mere (England), *Guanotrophy, Feces, Chironomidae, Chaoborus, Morphometric measurements, Phragmites, Typha, Carex, Polygonum, Nuphar, Nymphaea, Valvata, Micropsectra, Lundstroemia, Potamopyrgus, Glyptotendipes, Caenis, Ostracods, Limnodrius, Rhodomonas, Asterionella, Stephanodiscus, Limnodrilus, Stylodrilus, Microtendipes, Polypedilum, Aulodrilus, Helobdella, Glossiphonia, Pisidium, Sialis, Asellus, Potamothrix, Ilyodrilus.

Rostherne Mere, Cheshire, England, is a small lake with a maximum depth of about 30 meters. It is a normal dimictic eutrophic lake with a diverse benthic fauna, but the sediment in the deepest part is permanently deoxygenated and devoid of organisms other than copepods, probably in a dormant state. There is no dense layer of salt near the bottom and ammonia levels detected were not exceptionally high. The history of land-use around Rostherne Mere is not unique, and the human population is very small. The village received a piped water supply at the beginning of the century, but only sullage water reaches Rostherne Brook; three septic tanks drain into the mere, but their contribution of nutrients is negligible. Persistence of deoxygenated conditions in the sediments at the deepest part of Rostherne Mere and the associated presence of hydrogen sulfide render these sediments uninhabitable. In the absence of any significant organic pollution from human sources, this condition is attributed to deposition of feces from the very large bird population on the lake, both resident and transitory, especially the blackhead gulls (Larus ridibundus). (Jones-Wisconsin)
W70-04449

STUDIES ON SOME INLAND WATERS OF THE GALAPAGOS,
Wisconsin Univ., Milwaukee. Center for Great Lake Studies.
Richard Howmiller.
Ecology, Vol 50, No 1, p 72-80, 1969. 7 fig, 5 tab, 30 ref. NSF Grants GB 6870 and GB 6871.

Descriptors: *Saline lakes, *Water pollution sources, Birds, Oxygen, Nutrients, Photosynthesis, Chlorophyll, Shrimp, Fish, Lakes, Salinity.
Identifiers: *Guano, *Glapagos Islands, Ecuador, Corixids, Tanaid shrimp, Anostracan shrimp, Genovesa Island, Isabella Island, Guanotrophy.

Transparency, temperature, oxygen content, phosphorus, nitrite, nitrate, and hydrogen sulfide, pH value, salinity, plant pigments, and chlorophyll were determined in two large hypersaline lakes and three small ponds of lesser salt concentration in the Galapagos Islands. One of the lakes--Arcturus--is enriched in nutrients and organic matter by bird manure and presents an example of 'guanotrophy.' Another lake--Tagus Crater--has a rock salt bottom. Both lakes lack fish and their fauna is dominated by corixids and tanaid or anostracan shrimps. The ponds, in spite of their minute size (about 1/4 acre) harbor several species of fish. The study provides a transect-like picture of the influence of salinity and excessive content or organic fertilizer on physico-chemical features of water and survival of life forms. (Wilde-Wisconsin)
W70-04453

EFFECTS OF DAM CONSTRUCTION ON TEMPERATURES OF COLUMBIA RIVER,
Battelle-Northwest, Richland, Wash.
R. J. Jaske, and J. B. Goebel.
Journal American Waterworks Association, Vol. 59, p. 935-942, August 1967. 4 fig., 4 tab., 5 ref.

Descriptors: *Columbia River, *Thermal pollution, Data collections, Grand Coulee Dam, Ecology, *Temperature, Statistical models, Environmental effects, Dams, Dam construction, Reservoirs, Impoundments.
Identifiers: *Environmental model, Hybrid analog-digital computer, Temperature prediction, Lake Roosevelt, Rock Island Dam, Rocky Reach Dam, Travel time.

To evaluate the results of the program to reduce the temperature of the Columbia River to minimize the impact of powerplant operations, a system of data collection points was installed. The resulting data have been used to develop an environmental model, least square functional, which, with the use of a hybrid analog-digital computer, is capable of predicting temperature and associated water quality variables. Resulting data on stream and reservoir temperatures are presented. It was found that the erection of low-head reservoirs on the main stem of the Columbia River has not produced significant change in the average temperature of the river. The erection of Grand Coulee Dam on Lake Roosevelt

has resulted in a 30 day delay in the transport of water through the reservoir system. The erection of dams and reservoirs decreases expected variance in the water temperatures. The ecological effect of Columbia River impoundments is not comparable in size to large storage projects. (Rietveld-Vanderbilt)
W70-04474

A MATHEMATICAL MODEL OF STREAM TEMPERATURE,
Johns Hopkins Univ., Baltimore, Md.
D. W. Duttweiler.
Available from University Microfilms, Ann Arbor, Michigan. Ph. D. Thesis, The Johns Hopkins University, Baltimore, Md., 1963. 140 p, 23 fig., 15 tab., 54 ref.

Descriptors: *Water temperature, *Mathematical models, Air temperature, Climatology, Evaporation, *Heat balance, Heat transfer, Thermal pollution, Energy budget, Thermal radiation, Specific heat, Thermal properties, Convection, Pollutants, Heat flow, Thermal powerplants, Solar radiation, Electromagnetic waves, Streams, Lakes, Environmental effects, *Temperature.
Identifiers: Heat conductivity, Equilibrium temperature.

A mathematical model of stream temperature as a function of time and downstream distance was derived based on the approximately linear response of the stream to a 'temperature input function' T sub epsilon (t). The actual non-linear properties of the mechanism were demonstrated, and the necessary linear approximations in certain of the heat budget terms were developed. Independent expressions were given for T sub epsilon (t) and the exchange coefficient lambda, which permit their calculation from observations of climatological variables. The model was given a limited test to confirm the basic concept and verify expressions for T sub epsilon (t) and lambda. The expressions were tentatively shown to be satisfactory. The model was used to predict 19 hourly temperatures in a small stream, using one method, and 13 monthly average temperatures for a large lake, using another method, with moderate accuracy. The latter method was based solely on observed climatological variables. The model was shown to be useful in estimating downstream temperatures below a waste heat discharge and below the release of stored water in low-flow augmentation. (Novotny-Vanderbilt)
W70-04487

DISTRIBUTION OF NITRATES AND OTHER WATER POLLUTANTS UNDER FIELDS AND CORRALS IN THE MIDDLE SOUTH PLATTE VALLEY OF COLORADO,
Agricultural Research Service, Fort Collins, Colo. Northern Plains Branch; and Colorado Agricultural Experiment Station, Fort Collins.
B. A. Stewart, F. G. Viets, Jr., G. L. Hutchinson, W. D. Kemper, and F. E. Clark.
U S Department of Agriculture, Agricultural Research Service, ARS 41-134, December 1967, 206 p. 31 fig, 25 tab, 13 ref.

Descriptors: *Nitrates, *Ammonia, *Water pollution sources, *Cores, Fields, Plants, Alfalfa, Cereal crops, Irrigated land, Colorado, Groundwater, Percolation.
Identifiers: Native grasses, Feedlots, Corrals, South Platte Valley (Colo).

Cores representing nonirrigated fields in native grass, cultivated nonirrigated fields, irrigated fields in alfalfa, irrigated fields in crops other than alfalfa, and corrals were obtained from northeastern Colorado during 1966. Cultivated nonirrigated fields usually contained small accumulations of nitrate below the root zone. Native grass fields, ordinarily, did not show nitrate accumulation in core profiles. Significant quantities of nitrate were found in most cores from irrigated fields with row crops or cereal grains. Alternately, cores from irrigated alfalfa fields generally contained insignificant amounts of nitrate. Amounts of nitrogen as nitrate found under corrals were extremely varied, ranging from almost none to more than 5000 pounds/acre in a 20-foot profile. Evidence disclosed that denitrification was occurring under feedlots, even at several feet below the surface, consequently, much of nitrate under feedlots will probably never reach the water table. Water samples beneath several corrals contained large amounts of organic carbon and ammonia and possessed offensive odor. Bacterial counts under corrals were considerably higher than under other areas, especially at lower depths. These findings indicate some pollution of groundwater by deep percolation is occurring from corrals, but more studies are required before significance and magnitude of this pollution can be assessed. (Keeney-Wisconsin)
W70-04488

AGRICULTURAL DRAINAGE AND EUTROPHICATION,
Wisconsin Univ., Madison.
For primary bibliographic entry see Field 05C.
W70-04504

NUTRIENT OUTPUT FROM MANAGED FORESTS,
Michigan Univ., Ann Arbor.
For primary bibliographic entry see Field 05C.
W70-04505

5C. Effects of Pollution

VERTICAL AND HORIZONTAL DISTRIBUTION OF PHYTOPLANKTON IN QUABBIN RESERVOIR,
Massachusetts Univ., Amherst. Water Resources Research Center.
Paul A. Erickson, and John T. Reynolds.
Available from the Clearinghouse as PB-189 765, $3.00 in paper copy, $0.65 in microfiche. Interim Report, Massachusetts Water Resources Research Center, Publication No 9, Dec 1969. 44 p, 19 fig, 4 append. OWRR Project B-006-MASS.

Descriptors: *Phytoplankton, *Eutrophication, Reservoirs, Planning.
Identifiers: Microbial population patterns.

Phytoplanktonic data collected incidentally to the aims of the studies on eutrophication in Quabbin Reservoir are a significant addition to the knowledge of the characteristic phytoplankton in this major Massachusetts' Reservoir. Four distinct areas are defined in terms of the horizontal and vertical distribution of three types of phytoplankton, and these areas seem to correspond to subdivisions of the reservoir which can be made on the basis of other physical and chemical data. While such areas may or may not prove to be of general ecological significance in the light of more exhaustive studies, even preliminary evidence of consistent phytoplanktonic differences throughout the reservoir might help to define the aims and direct the efforts of any future study of eutrophication in Quabbin. Information on such differences is particularly important today because diversions of water into Quabbin from polluted sources such as the Connecticut River are being contemplated, and because the basis for a measurement of the efficiency and effect of treatment plants constructed as part of those diversions will be a knowledge of microbial population patterns in Quabbin prior to the mixing.
W70-04046

STUDIES ON THE POPULATION DYNAMICS AND PHYSIOLOGICAL ECOLOGY OF FOUR SPECIES OF FRESH-WATER ISOPODS,
Illinois Univ., Urbana. Water Resources Center.
Arthur J. Seidenberg.
Available from the Clearinghouse as PB-189 792, $3.00 in paper copy, $0.65 in microfiche. Completion Report, Illinois Water Resources Center, Research Report No 27, Jan 1970 69 p, 6 tab, 24 fig, 85 ref. OWRR Project A-018-ILL.

Descriptors: Isopods, Fish parasities
Identifiers: Parasite, Asellus, Lirceus, Acanthocephalus, Thermal tolerance, Pollution fauna, Population dynamics, Host-parasite relationships.

The comparative biology of four species of freshwater isopods has been investigated. Isopods are known to be part of the 'pollution fauna' that can inhabit badly polluted areas. The species studies inhabit a temporary pond, a drainage ditch, a small permanent stream, and the subterranean water, all relatively undisturbed areas. Their tolerance to high temperature and survival out of water, growth rates, and duration of embryonic development have been investigated and differences among the species have been suggested to be adaptive for the particular population under study. The general population biology of these species was studies including their life cycles and general ecology. The 'basic biology' reported for these organisms will allow investigators to assess more clearly the effects of man-made disturbances on these aquatic organisms. One of the species studied was found to be an intermediate host of a worm that is a fish parasite. The host-parasite relationships between the worm and the isopod were also investigated. Fish acquire the parasite after eating the isopod. The isopod population was found to be very heavily infected (up to 65%) with these worm larvae. The larvae cause the isopods to lose weight and produce a mortality in heavily infected isopods. This means a drastic reduction in the amount of isopod food available to fish.
W70-04073

APPLICATION OF RADIOISOTOPE TECHNIQUES TO A CRITICAL WATER RESOURCES PROBLEM AREA - NAMELY NUTRITIONAL POLLUTION,
Oklahoma Univ., Norman. Dept. of Civil Engineering and Sanitary Science; and Arkansas Univ., Fayetteville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05A.
W70-04074

CHEMISTRY OF NITROGEN AND PHOSPHORUS IN WATER,
P. L. McCarty.
Journal American Water Works Association, Vol 62, No 2, p 127-140, Feb 1970. 14 p, 6 fig, 8 tab, 64 ref.

Descriptors: *Nutrients, *Eutrophication, *Water quality control, *Nitrogen compounds, *Phosphorus compounds, Algae, Nutrient requirements, Productivity, Essential nutrients, Water quality, Water chemistry, Cycling nutrients.
Identifiers: Nitrogen requirements (Algae), Phosphorus requirements (Algae), Nutrient chemistry (Aquatic).

Of the major elements essential to algal growth, nitrogen and phosphorus are the ones most likely to be of critically limiting availability in natural waters. Because they therefore represent promising weak links in algal life cycles, their chemical states and behavior in water are examined to see how water treatment might benefit. Large supplies of nitrogen and phosphorus are present in many bodies of water either in the sediments, the atmosphere above, or in the form of dissolved gas. These forms may be available for the growth of algae and other aquatic plants, but the rates at which they may become available is slow. These rates are important, however, as they tend to control the amount of vegetative growth which can be supported. Soluble nitrogen and phosphorus contained in the effluents from waste treatment plants, on the other hand, are in a readily available form. If discharged to natural bodies of water, they can stimulate growth far in excess of that which would occur naturally. (Knapp-USGS)
W70-04080

DEFORMATION OF DEVELOPING EMBRYOS OF SEA URCHINS WITH CHANGES IN THE IONIC ENVIRONMENT,
McGill Univ., Montreal (Quebec). Dept. of Zoology.
N. Wolfson.
Canadian Journal of Zoology, Vol 47, No 6, p 1363-1365, 1969. 4 fig, 16 ref.

Descriptors: *Deformation, *Environmental effects, Embryonic growth stage, Sodium chloride, Calcium.
Identifiers: *Paracentrotus lividus, *Embryonic development, *Abnormal development, Ionic environmental changes, Fertilization membranes, Blastulae, Speudopods, Ameboid transformations.

Embryos of Paracentrotus lividus, deprived of their fertilization membranes and exposed for periods of 10-120 min to cold buffered isotonic NaCl at various cleavage stages, will often exhibit pseudopodial extensions of the external surface of blastomeres still in embryonic association. Similarly treated embryos allowed to develop for 1-2 days in seawater will often fuse to produce large monsters with continuous blastocoels. Photographs of living embryos displaying blastomeric pseudopods and multiembryonic fusion are presented. The exposure of embryos to artificial saline may promote losses of calcium, of hyaline layer, and perhaps of other superficial components, some of which are reversible losses and others not, after return to seawater. (Katz and Sjolseth-Washington)
W70-04144

A CHEMICAL SELECTIVELY LETHAL TO SQUAWFISH (PTYCHOCHEILUS OREGONENSIS AND P. UMPQUAE),
Idaho Univ., Moscow.
Craig MacPhee, and Richard Ruelle.
Contract with the Columbia River Fishery, Development Program, Bu. of Commercial Fisheries, U.S. Fish and Wildlife Service. Transactions of the American Fisheries Society, Vol 98, No 4, p 676-684, Oct 1969. 6 tab, 3 fig, 9 ref.

Descriptors: *Fish control agents, *Bioassay, *Resistance, *Selectivity, Fish management, Toxicity, Salmonids, Mortality, Public health.
Identifiers: *Squawfish, Ptychocheilus oregonensis, Ptychochelus umpqua, *1-1'-methlenedi-2-naphthol, *Water temperature effects, *Tolerance.

A piscicide, 1,1'-methylenedi-2-naphthol, is lethal to Ptychocheilus oregonensis and P. umpqua at concentrations of 3 to 100 times more toxic to squawfish than to salmonids. Selectivity of the chemical varies with the tolerances of the species and its potency varies positively with concentration and temperature. For a thermal range of 18.3 to 10.0 C, the minimum LC sub 100 is .006 to 0.014 ppm for P. oregonensis and 0101 to 0103 ppm for P. umpquae. Within these ranges the mean survival time varies from 6 to 31 hr for P. oregonensis and 6 to 20 hr for P. umpquae. In 96 -hour assays at similar temperature, the maximum LC sub 0 is about 0.3 ppm for Salvelinus fontinalis, 0.1 ppm for Oncorhynchus tshawytscha, and from 0.6 to 1.3 ppm for O. kisutch and Salmo gairdneri depending on the water temperature. One domestic sheep and two ducks showed no ill effects when forced to drink water containing 10 ppm of the chemical for 1 week. A field application in a small lagoon containing several species of fish killed only P. oregonensis. (Katz and Sjolseth-Washington)
W70-04145

OXYGEN CONSUMPTION OF ENDRIN-SUSCEPTIBLE AND ENDRIN-RESISTANT GAMBUSIA DURING SUBLETHAL AND ACUTE ENDRIN EXPOSURE,
Mississippi State Univ., State College.
Charm R. McIngvale, Larry Ludke, and Denzel E. Ferguson.
Journal of the Mississippi Academy of Sciences, Vol XIV, 1968. Reprint, 6 p, 3 fig, 6 ref. US Public Health Service Grants ES-00086 and UI-00348.

Descriptors: *Endrin, *Respiration, Oxygen requirements, Resistance, Chlorinated hydrocarbon pesticides.
Identifiers: *Oxygen consumption, Mosquitofish, Gambusia affinis, Endrin-resistance, Susceptible mosquitofish.

The rate of oxygen consumption of endrin-resistant mosquitofish, Gambusia affinis, was significantly lower (26%) than that of a susceptible strain. Susceptible individuals showed an increase in rate of oxygen uptake with the onsent of poisoning symptoms, followed by a decrease prior to death. Resistant fish exhibited no consistent change in rate of oxygen consumption in endrin. When susceptible fish were subjected for 3 hours to 0.1, 2.0, and 10.0 ppb endrin, none died and oxygen uptake fell below the control group, but only the 0.1 ppb data differed significantly. At higher concentrations of exposure (20 and 75 ppb) the total oxygen consumed by susceptible fish decreased significantly from the control group. Total oxygen consumed over a 3 hour test period and average rate of uptake of resistant mosquitofish did not differ significantly between the control and treated groups. (Katz and Sjolseth-Washington)
W70-04146

RESPONSE OF THE GLOBIFEROUS PEDICELLARIAE TO INORGANIC SALTS IN THREE REGULAR ECHINOIDS,
Newcastle-upon-Tyne Univ. (England). Dove Marine Lab.
Fu-Shiang Chia.
Ophelia, Vol 6, p 203-210, July 1969. 3 fig, 20 ref.

Descriptors: *Inorganic compounds, *Copper sulfate, Potassium compounds, Venoms, Mode of action.
Identifiers: *Pedicellariae, *Echinodermata, *Inorganic salts, *Activation, *Avoidance responses, Echinus esculentus, Zinc salts, Potassium chloride, Potassium sulfate, Psammechinus miliaris, Strongylocentrotus droebachiensis, Response, Starfishes.

The globiferous pedicellariae of Echinus esculentus (L.), Psammechinus miliaris (Gmelin) and Strongylocentrotus droebachiensis (O.F.M.) may be activated by a number of inorganic salts such as ZnCl2, ZnSO4, CuCl2, CuSO4, KCl, and K2SO4, even at great dilutions; the reaction is similar to that evoked by predatory starfishes. The discharge of venom may also be induced by potassium salts both in situ as well as with isolated pedicellariae. In all three species, the venom discharges through the fang-like tooth via a small opening located in a subterminal position. The venom apparatus functions as a hypodermic syringe which injects the venom directly into the wound. After discharge, the pedicellaria breaks away from the test at the base of the stalk (autotomy). In Psammechinus, it takes 25 days to regenerate a new and functional pedicellaria. (Katz and Sjolseth-Washington)
W70-04147

PESTICIDE TOLERANCES OF SELECTED FRESHWATER INVERTEBRATES,
Mississippi State Univ., State College.
Syed M. Naqvi, and Denzel E. Ferguson.
Journal of the Mississippi Academy of Sciences, Vol XIV, 1968. Reprint, 7 p, 4 tab, 6 ref. US Public Health Service Grants ES-00086 and UI-00348.

Descriptors: *Chlorinated hydrocarbon pesticides, *Organophosphorus pesticides, *Pesticide toxicity, *Bioassays, *Copepods, DDT, Endrin, Aldrin, Dieldrin, Mortality, Snails, Clams, Tubificids, Resistance, Food pyramids.
Identifiers: *Physa gyrina, *Tolerances, Chlordane, Lindane, Malathion, Phosdrin, Toxaphene, Parathion, Eupera singleyi, Tubifex tubifex, Belzoni (Miss), State College (Miss).

In a 48-hr exposure to various concentrations of nine insecticides, six species of cyclopoid copepods from a pesticide contaminated ditch near Belzoni, Mississippi, displayed higher tolerances than did the same species from areas of minimal pesticide contamination near State College, Mississippi. Similarly, a clam, Eupera singleyi, and a snail, Physa gyrina, from the Belzoni locality had higher tolerances to endrin and toxaphene than the same species from near State College. Extremely high concentrations of 20 insecticides failed to kill the worm Tubifex tubifex, from Belzoni in 72-hr tests. The potential effect of increased tolerances in these invertebrate species is to increase the amount of pesticide residues available to higher trophic levels. (Katz and Sjolseth-Washington)
W70-04149

A LIMNOLOGICAL STUDY OF THE LOWER FARMINGTON RIVER WITH SPECIAL REFERENCE TO THE ABILITY OF THE RIVER TO SUPPORT AMERICAN SHAD,
Connecticut Univ., Storrs. Dept. of Fisheries.
Walter R. Whiteworth, and David H. Bennett.
Institue of Water Resources, University of Connecticut, Rept No 9, Feb 1970. 57 p, 29 tab, 7 fig, 26 ref. Supported in part by the Connecticut Research Commission (Grant No RSA 66-5).

Descriptors: *Limnology, *Bioassay, *Water pollution effects, *Effluents, Aquatic environment, Biological properties, Chemical properties, Biochemical oxygen demand, Plankton, Zooplankton, Sampling, Hydrogen ion concentration, Community development, Metabolism, Ecological distribution, Water temperature, Heavy metals, Oxygen requirements, Industrial waste.
Identifiers: *Alosa sapidissima, *Lead, American shad, Farmington River, Connecticut, Connecticut River, Colonization, Community metabolism, Bottom fauna.

Fish, plankton, bottom fauna, and water were sampled in the Lower Farmington River as part of a comprehensive limnological survey. Water temperature, B.O.D., rate of slide colonization tests, estimates of community metabolism and effects of effluents were studied. Laboratory and field bioassays using various fish were conducted with effluents common to the Farmington River. The effects of fluctuating DO levels on hatching of shad eggs were studied. Shad were transferred into the River and from the data collected the authors conclude that the River is capable of supporting a significant shad run, and should not be measurably affected by the effluent discharge. A set of 5 recommendations concerned with building the shad runs is presented. (Katz and Sjolseth-Washington)
W70-04150

EFFECT OF FEEDING AND OF DDT ON THE ACTIVITY OF HEPATIC GLUCOSE 6-PHOSPHATE DEHYDROGENASE IN TWO SALMONIDS,
Bureau of Sport Fisheries and Wildlife, Columbia, Mo. Fish-Pesticide Research Lab.
Donald R. Buhler, and P. Benville.
Journal Fisheries Research Board of Canada, Vol 26, No 12, p 3209-3216, 1969. 5 tab, 27 ref.

Descriptors: *DDT, *Enzyme, *Fish physiology, Rainbow trout, Fish diets, Chlorinated hydrocarbon pesticides, Pesticide toxicity.
Identifiers: *Insulin, *Hepatic enzymes, Enzyme activity, Coho salmon, Starvation, Liver size.

The specific activity of liver glucose 6-phosphate dehydrogenase in yearling rainbow trout remained unchanged when the fish were starved for periods as long as 8 weeks and when starved animals were fed diets of various compositions. Injection of insulin concurrently with refeeding also failed to alter the specific activity of the enzyme in trout. Ingestion of the pesticide DDT by juvenile coho salmon or adult rainbow trout also had no effect on the specific activity of liver glucose 6-P dehydrogenase and DDT failed to inhibit the rainbow trout enzyme in vitro. These results also differ considerably from those found in higher animals. These results suggest that the glucose 6-P

dehydrogenase enzyme in teleosts may be under a different type of regulatory control from that found in mammals. (Sjolseth-Washington)
W70-04151

ACUTE TOXICITIES OF INSECTICIDES TO MARINE DECAPOD CRUSTACEANS,
Bureau of Sport Fisheries and Wildlife, Highland, N.J. Fish-Pesticide Research Lab.
Ronald Eisler.
Crustaceana, Vol 16, Part 3, p 302-310, 1969. 4 fig, 3 tab, 20 ref.

Descriptors: *Bioassay, *DDT, *Pesticide toxicity, Chlorinated hydrocarbon pesticides, Organophosphorus pesticides, Endrin, Aldrin, Heptachlor, Dieldrin, Salinity, Water temperature, Resistance, *Crustaceans.
Identifiers: *Malathion, *Methyl parathion, DDVP, Palaemonetes vulgaris, Crangon septemspinosa, Pagurus longicarpus, LC 50.

The concentrations of seven chlorinated hydrocarbon pesticides (aldrin, dieldrin, endrin, heptachlor, lindane, methoxychlor, and DDT) and 5 organophosphorus pesticides (DDVP, Delnav, phosdrin, malathion, and methyl parathion) that kill 50 percent of 3 decapod crustaceans (grass shrimp, sand shrimps and hermit crabs) during a 96 hour period were determined at different temperatures and salinities. Sand shrimp are the most sensitive to all insecticides. Of the chlorinated hydrocarbons, heptachlor is the least toxic to all species (96 hr, LC-50 range of 8 ug/l for sand shrimp to 440 ug/l for grass shrimp) and DDT about the most toxic (96 hr, LC-50 range of 0.6 ug/l for sand shrimp to 6 ug/l for hermit crabs). Of the organophosphorus pesticides, methyl parathion is the most toxic (96 hr, LC-50 range of 2-7 ug/l) and Delnav or malathion the least toxic (96 hr, LC-50 range of 33-285 ug/l). Temperature and salinity profoundly affect the mortality. Mortality among shrimp was least at 10 deg and highest at 30 deg C and intermediate at intermediate temperatures for all insecticides. The effect of salinity varied among the insecticides. (Sjolseth-Washington)
W70-04152

TOXICITY OF PESTICIDE INGREDIENTS TO SOME FRESH WATER ORGANISMS (JAPANESE),
Agricultural Chemical Inspection Station, Tokyo (Japan).
Yasushiro Nishuichi, and Yasushi Hashimoto.
English summary - Tables in English. Scientific Pest Control, BOTYU-KAGAKU, Vol 32, I. The Institue of Insect Control, Kyoto University, p 5-11, Feb 1967. 5 tab, 3 fig, 7 ref.

Descriptors: *Pesticide toxicity, *Bioassay, *Organophosphorus pesticides, *Chlorinated hydrocarbon pesticides, *Carbamate pesticides, *Solvents, Fungicides, Herbicides, Lethal limit.
Identifiers: *Organomercuric compounds, *Organotin compounds, *Organosulfuric fungicides, Cyprinus carpio, Daphnia, Oryzias latipes, Median tolerance limits, Susceptibility.

Toxicities of seventy-six kinds of pesticide ingredients to three kinds of fresh water fishes and two kinds of fresh water daphnids were evaluated. The test organisms are Cyprinus carpio, C. auratux, Oryzias latipes, and Moina macrocopa. In general, organophosphorus compounds are less toxic to fresh water fishes, while these are remarkably toxic to daphnids. Chlorinated hydrocarbon compounds are remarkably toxic to the fishes, but not so toxic to daphnids. An exception is Thiodan, which is remarkably toxic to both fishes and daphnids. Carbamate insecticides are non-toxic to fishes, but specifically toxic to daphnids. Organomercuric and organotin compounds are remarkably toxic to both fishes and daphnids. Organoarsenic fungicides are low toxicity to both fishes and daphnids. Organosulfuric and the other synthetized fungicides tested are highly toxic to fishes, but not so toxic to daphnids. Herbicides are generally non-toxic to both fishes and daphnids, but some of them are toxic. Fresh water fishes and daphnids are clearly different in susceptibility to pesticides. A considerably high correlation is recognized between the susceptibility of Cyprinus carpio and C. auratus, and between Daphnia pulex and Moina macrocopa. Orizias latipes is selectively susceptible to some kinds of pesticide ingredients. (Sjolseth and Katz-Washington)
W70-04153

LETHAL EFFECTS OF 1888 CHEMICALS UPON FOUR SPECIES OF FISH FROM WESTERN NORTH AMERICA,
Idaho Univ., Moscow. Coll. of Forestry-Wildlife and Range Sciences.
Craig MacPhee, and Richard Ruelle.
Contract with the Columbia River Fishery Development Program, Bu of Comm Fish, US Fish and Wildlife Service. Forest, Wildlife and Range Experiment Station, Bull No 3, Univ of Idaho, College of Forestry - Wildlife and Range Sciences, Nov 1969. 112 p, 4 tab, 2 ref.

Descriptors: *Bioassay, Chinook salmon, Rainbow trout, *Lethal limit, Mortality, *Toxicity, Pollutants, *Toxins, Wastes.
Identifiers: Equilibrium loss, Coho salmon, Steelhead, Northern squawfish.

A piscicide screening program was conducted with 1,888 different chemicals mostly at concentrations of 10 ppm. The times at which fish lost their equilibrium and died are given for 2,552 separate 24-hour assays. The species tested were the northern squawfish (Ptychocheilus oregonensis) chinook salmon (Oncorhynchus tshawytscha), coho salmon (Oncorhynchus kisutch) and steelhead (Salmo gairdneri). (Sjolseth and Katz-Washington)
W70-04154

EFFECTS OF THE INSECTICIDE SEVIN ON SURVIVAL AND GROWTH OF THE COCKLE CLAM CLINOCARDIUM NUTALLI,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
Jerry A. Butler, Raymond E. Millemann, and Nelson E. Stewart.
Supported by Public Health Service Research Grant CC-00303 from the National Communicable Disease Center, Atlanta, Ga. Journal Fisheries Research Board of Canada, Vol 25, No 8, p 1621-1635, 1968. 6 tab, 2 fig, 22 ref.

Descriptors: *Carbamate pesticides, *Growth rates, *Bioassay, Pesticide toxicity, Clams, Animal control, Pesticide residues, Mortality, Water temperature, Pesticide removal.
Identifiers: *Sevin, *1-naphthol, *Food consumption, Food conversion efficiency, Survival, Clinocardium nutalli.

Experiments are reported on the effects of the insecticide Sevin and its hydrolytic product, 1-naphthol, on the survival, growth, and food consumption of larval and juvenile cockle clams (Clinocardium nuttalli). Toxicant concentrations ranged from 0.1 to 10.0 mg/liter. Larvae exposed to Sevin concentrations of 0.8 mg/liter were dead by day 7 of the test, and the growth of those exposed to 0.4 mg/liter was reduced by 15%. Sevin was less toxic than 1-naphthol to juvenile clams, the respective 96-hr TL's (median tolerance limits) being 3.75 and 2.70 mg/liter. The growth of juvenile clams was reduced more by 1-naphthol than by Sevin. The food consumption of juvenile clams exposed to 1.6 mg/liter of Sevin was markedly reduced and their food conversion efficiency was impaired. Adult clams exposed to Sevin concentrated the toxicant in their tissues; maximum concentrations were reached after 12 hr of exposure. Clams exposed at 11 C concentrated more toxicant than those exposed at 20 C. Tissue concentrations of toxicant decreased sharply after the clams had been in clean sea water for 12 hr. (Sjolseth and Katz-Washington)
W70-04155

THE CALCULATION OF THE ACUTE TOXICITY OF MIXTURES OF POISONS TO RAINBOW TROUT,
Water Pollution Research Lab., Stevenage (England).
For primary bibliographic entry see Field 05A
W70-04156

BIOLOGICAL EFFECTS OF THERMAL DISCHARGES: ANNUAL PROGRESS REPORT FOR 1968,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.
W. L. Templeton, C. D. Becker, J. D. Berlin, C. C. Coutant, and J. M. Dean.
Reprinted from Pacific Northwest Laboratory Annual Report for 1968 to USAEC Division of Biology and Medicine, Volume I: Life Sciences. USAEC Research and Development Report No BNWL-1050, Dec 1969. 49 p.

Descriptors: *Thermal pollution, *Thermal stress, Water pollution effects, *Salmoids, *Columbia River, *Fish physiology, Fishkill, Nuclear reactors, Water temperature, Fish behavior.
Identifiers: Thermal resistance, Thermal shock, Thermal tolerance.

This is the second annual report issued by Battelle-Northwest's Aquatic Ecology Section which deals exclusively with research to determine the effects of thermal additions to aquatic environments. The individual papers, all separately abstracted, include the following titles: Responses of Salmonid Fishes to Acute Thermal Shock, Passage of Downstream Migrants, Chinook Salmon Spawning Ner Hanford - 1968, Gull Predation in a Reactor Discharge Plume, Effects of Chronic Variable Water Temperature on Survival and Growth of Young Chinook Salmon, Behavior of Sonic-Tagged Chinook Salmon and Steelhead Trout Migrating Past Hanford Thermal Discharges, The Food and Feeding of Juvenile Chinook Salmon in the Columbia River at Hanford, Columnaris Exposure and Antibody Development Among Upstream Migrant Salmonids, Oral Immunization of Juvenile Coho Salmon Against Chondrococcus Columnaris, The Response of Juvenile Salmonids to Acute Thermal Shock, and Alterations in Hepatocyte Function of Thermally Acclimated Rainbow Trout (Salmo Grirdneri). (See also W70-04158 thru W70-04163).
W70-04157

RESPONSES OF SALMONID FISHES TO ACUTE THERMAL SHOCK,
Battelle-Northwest, Richland, Wash.
C. C. Coutant.
In Biological Effects of Thermal Discharges: Annual Progress Report for 1968, p 1-8, Dec 1969. 6 fig, 2 tab, 1 ref.

Descriptors: *Thermal pollution, *Thermal stress, *Fishkill, Rainbow trout, Chinook salmon, Salmonids, Equilibrium, Water temperature, Mortality, Resistance, Fish predation, Fish behavior, Columbia River, Nuclear reactors.
Identifiers: *Thermal shock, *Thermal resistance, Coho salmon, Hanford Atomic Works.

Chinook salmon, coho salmon, and rainbow trout were subjected to acute thermal shock in order to determine any relationships between times to equilibrium loss and death of fish populations. There is a variation with test temperature in the relationship between times to equilibrium loss and death in juvenile chinook salmon and rainbow trout. Chinook salmon and rainbow trout undergo increased predation at sublethal exposures to lethal temperature. Equilibrium loss due to thermal shock is not reversible at all lethal temperatures, for the studies show large delayed mortality of rainbow trout 24 hours after exposure to 27-30 deg C. Above 30 deg C equilibrium loss is reversible. Thermal resistance differences between juvenile and large coho and chinook salmon in addition to species differences were found. Above 28 deg C juvenile chinook are most sensitive, then juvenile

coho, adult coho and adult chinook and below 28 deg C it is adult coho, juvenile chinook and juvenile coho the least sensitive. (See W70-04157). (Sjolseth-Washington)
W70-04158

PASSAGE OF DOWNSTREAM MIGRANTS,
Battelle-Northwest, Richland, Wash.
C. C. Coutant, C. D. Becker, and E. F. Prentice.
Biological Effects of Thermal Discharges: Annual Progress Report for 1968, p 9-12, Dec 1969. 2 fig, 1 tab.

Descriptors: *Thermal pollution, *Thermal stress, *Acclimatization, Chinook salmon, Fishkill, Equilibrium, Water temperature, Columbia River, Mortality, Nuclear reactors.
Identifiers: *Thermal resistance, *Thermal shock, Hanford Atomic Works.

Juvenile chinook salmon were confined to live boxes which were drifted through reactor discharge plumes below Hanford on the Columbia River. No direct or 24 hour latent mortalities were induced during spring and summer. Shoreline areas affected by intragravel seepage of heated water reached lethal levels for chinook. In these area losses of test fish during mid-summer occurred. Most temperature rises did not exceed the ultimate incipient lethal level for the species. Emigrating juvenile chinook trapped in May following passage through the warmest part of the thermal discharge plume showed no mortality, equilibrium loss or 'gas bubble' disease. The authors feel that most emigrating juvenile salmon are successful in passing areas of maximum thermal change at Hanford. (See W70-04157). (Sjolseth-Washington)
W70-04159

EFFECTS OF CHRONIC VARIABLE WATER TEMPERATURES ON SURVIVAL AND GROWTH OF YOUNG CHINOOK SALMON,
Battelle-Northwest, Richland, Wash.
P. A. Olson, and R. E. Nakatani.
Biological Effects of Thermal Discharges: Annual Progress Report for 1968, p 17-20, Dec 1969. 1 fig, 1 tab.

Descriptors: *Fishkill, *Fish eggs, *Thermal pollution, *Growth rate, Chinook salmon, Columbia River, Spawning, Mortality, Thermal stress, Resistance, Nuclear reactors.
Identifiers: *Thermal resistance, Hanford Atomic Works.

Fertilized eggs from five pairs of chinook salmon were taken and exposed to six different temperature regimes following the Columbia River's seasonal pattern and expressing different heating rates on a cumulative weekly basis during early development. A constant temperature increment above base river temperatures of 2.5 deg C caused slightly increased egg mortalities. An eventual 5 deg C increment above base river temperatures produced no increased mortality in the majority of spawns when added by 20 cumulative weekly increments of 0.25 deg C, although increased mortality occurred if this 5 deg C rise was done at 0.5 deg C for 10 weeks. It was noticed that warmer water condtions resulted in increased growth rates. (See W70-04157). (Sjolseth-Washington)
W70-04160

BEHAVIOR OF SONIC-TAGGED CHINOOK SALMON AND STEELHEAD TROUT MIGRATING PAST HANDFORD THERMAL DISCHARGES,
Battelle-Northwest, Richland, Wash.
C. C. Coutant.
Biological Effects of Thermal Discharges: Annual Progress Report for 1968, p 21-26, Dec 1969. 1 tab, 2 fig.

Descriptors: *Thermal pollution, *Fish behavior, *Fish migration, Chinook salmon, Rainbow trout, Columbia River, Nuclear reactors, Thermal stress, Water temperature, Distribution patterns, Tagging.
Identifiers: *Steelhead trout, *Sonic fish tags, Hanford Atomic Works, Migration rates.

Eighty-nine chinook salmon and 279 steelhead were marked with sonic tags to determine their pathways of spawning migrations as they move through the warm waters surrounding the Hanford facilities. The fish were found to migrate mainly along the shoreline, principally utilizing the left bank opposite the reactors during peak river temperatures. No statistical difference was found between migration rates of the two species or between rates along shorelines inside and outside the reactors' thermal influence. Average migration rates were studied and found to be distinctly nonuniform. The authors feel there is insufficient data available to identify the causes of anomalies in distribution and migration rate. (Sjolseth-Washington)
W70-04161

THE FOOD AND FEEDING OF JUVENILE CHINOOK SALMON IN THE COLUMBIA RIVER AT HANFORD,
Battelle-Northwest, Richland, Wash.
D. C. Becker.
Biological Effects of Thermal Discharges: Annual Progress Report for 1968, p 27-31, Dec 1969. 1 tab, 1 fig, 2 ref.

Descriptors: *Fish diets, *Aquatic insects, *Thermal pollution, Chinook salmon, Columbia River, Nuclear reactors, Water temperature.
Identifiers: *Feeding activity, *Fish stomach contents, Hanford Atomic Works, Terrestrial insects, Chironomids.

Stomach contents of 445 young chinook salmon taken near Hanford were examined. They fed primarily upon aquatic insects, mainly chironomids, and secondarily on terrestrial insects. No evidence was found to suggest that heated effluents discharged in midwater plumes and which rapidly mix with the colder river water adversely affects either insect production or feeding activity of fish. Food intake was restricted in a few shoreline areas receiving warm water via intragravel seepage. The author feels that thermal discharge to the river, when waters are below preferred levels during spring runoff, may actually benefit the fish. (Sjolseth-Washington)
W70-04162

THE RESPONSE OF JUVENILE SALMONIDS TO ACUTE THERMAL SHOCK,
Battelle-Northwest, Richland, Wash.
J. M. Dean.
Biological Effects of Thermal Discharges: Annual Progress Report for 1968, p 41-46, Dec 1969. 2 tab, 3 fig.

Descriptors: *Thermal stress, *Acclimatization, *Fish behavior, *Mortality, Chinook salmon, Salmonids, Water temperature, Thermal pollution, Fishkill, Resistance, Fish physiology.
Identifiers: *Thermal shock, *Thermal tolerance, Coho salmon, Muscle temperature.

Juvenile coho and chinook salmon were acclimated at 10, 15, or 20 deg C and transferred in lots of ten to water temperatures of 25-30 deg C. Temperature acclimation will shift the thermal limits of behavioral and physiological responses. The absolute limits differed for various species of salmonids but the overall response was similar. The author stressed the need for more observations of the reactions of organisms to thermal stress so that adequate thermal criteria can be established. (Sjolseth-Washington)
W70-04163

PERSISTENCE OF CARBARYL IN THE MARINE ESTUARINE ENVIRONMENT. CHEMICAL AND BIOLOGICAL STABILITY IN AQUARIUM SYSTEMS,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife; and Oregon State Univ., Corvallis. Dept. of Agricultural Chemistry.
J. F. Karinen, J. G. Lamberton, N. E. Stewart, and L. C. Terriere.
Journal of Agricultural and Food Chemistry, Vol 15, p 148-156, Jan-Feb 1967. 2 tab, 5 fig, 16 ref. US Public Health Service Research Grant 5 RO1 EF 00628-02.

Descriptors: *Persistence, *Carbamate pesticides, *Estuarine environment, *Degradation, Carbon radio isotopes, Pesticide removal, Hydrolysis, Pest control, Mud flats, Colorimetry, Stability, Absorption.
Identifiers: *Sevin, *1-naphthol, *Carbaryl, Radiometric analyses.

Colorimetric and radiometric analyses were used to study the persistence of carbaryl in estuarine water and mud in laboratory aquaria held at two temperatures. In the absence of mud, the carbaryl concentration decreased approximately 50% in 38 days at 8 deg C. Most of this decrease was accounted for by the production of 1-naphthol. At 20 deg C after 17 days, the carbaryl had almost completely disappeared, with 43% converting to 1-naphthol. When mud was present, both carbaryl and 1-naphthol declined to less than 10% in the sea water in 10 days. Both compounds were adsorbed by the mud, where decomposition continued at a slower rate. Radioactive carbon dioxide was produced in the aquaria containing 14C carbonyl-labeled and 14C ring-labeled carbaryl, indicating decomposition by hydrolysis of the carbamate and oxidation of the naphthyl ring. The total recovery of the 14C activity was only 40%. It is postulated that much of the remainder was evolved as methane. In a preliminary field experiment in which a portion of a mud flat was treated with carbaryl at rates similar to those used in the control of pests of oyster beds, carbaryl could be detected in the mud for 42 days. 1-Naphthol persisted in significant quantities for only one day. (Katz and Sjolseth-Washington)
W70-04164

ACUTE TOXICITY OF THE INSECTICIDE SEVIN AND ITS HYDROLYTIC PRODUCT 1-NAPHTHOL TO SOME MARINE ORGANISMS,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
Nelson E. Stewart, Raymond E. Millemann, and Wilbur P. Breese.
Transactions of the American Fisheries Society, Vol 96, No 1, p 25-30, Jan 1967. 2 tab, 20 ref. US Public Health Service Research Grant 5 RO1 EF 00628-02.

Descriptors: *Pesticide toxicity, *Crustaceans, *Mollusks, *Bioassays, Shrimp, Crabs, Perches, Stickelbacks, Mortality, Resistance, Water temperature, Larvae.
Identifiers: *Sevin, *1-naphthol, *Tolerance, Mytilus edulis, Crassostrea gigas, Clinocardium nuttallii, Parophrys vetulus.

The acute toxicity of Sevin (1-naphthyl N-methylcarbamate) and its hydrolytic product 1-naphthol to 10 species of marine animals was determined. Sevin was more toxic to larval and adult crustaceans (Upogebia pugettensis, Callianassa californiensis, Hamigrapsus oregonensis, Cancer magister) than to larval and adult mollusks. (Mytilus edulis, Crassostrea gigas, Clinocardium nuttallii) and juvenile fishes (Cymatogaster aggregata, Parophrys vetulus, Gasterosteus aculeatus). Sevin was 30 to 300 times more toxic than 1-naphthol to the crustaceans but less toxic than 1-naphthol to the mollusks and fishes. (Katz and Sjolseth-Washington)
W70-04165

REDUCED OXYGEN TOLERANCE AND TOXICITY OF PETROLEUM PRODUCTS TO JUVENILE AMERICAN SHAD,
Bureau of Commercial Fisheries, Beaufort, N.C. Biological Lab.
Marlin E. Tagatz.
Chesapeake Science, Vol 2, No 1-2, p 65-71, Mar-June 1961. 5 tab, 20 ref.

Descriptors: *Bioassay, *Oxygen requirements, *Dissolved oxygen, *Gasoline, Water pollution effects, Oily water, Toxicity, Oxygen demand, Oil, Mortality, Fishkill, Fisheries, Acclimatization.
Identifiers: *Petroleum products, *Alosa sapidissima, *Diesel fuel oil, *Tolerances, Bunker oil, American shad.

Experiments were conducted on juvenile American shad, Alosa sapidissima, to indicate tolerance to reduced oxygen, toxicity of petroleum products, and toxicity of petroleum products with accompanying low dissolved oxygen. All mortalities in reduced oxygen tests occurred at dissolved oxygen values of less than 2 ppm with lethal concentrations varying with the rate of reduction. No mortalities occurred when dissolved oxygen was maintained between 2 and 4 ppm. TL sub m values were determined for gasoline, diesel fuel oil, and bunker oil for 24- and 48-hour periods. Gasoline was the most toxic, fuel oil somewhat less toxic, and bunker oil least toxic. The lethality of petroleum products to shad was found to increase when accompanied by low dissolved oxygen. (Katz and Sjolseth-Washington)
W70-04166

ZOOPLANKTON STANDING CROPS IN A NEW AND AN OLD OZARK RESERVOIR,
Bureau of Sport Fisheries and Wildlife, Fayetteville, Ark.
Richard L. Applegate, and James W. Mullan.
Limnology and Oceanography, Vol 12, No 4, p 593-599, 1967. 4 fig, 5 tab, 18 ref.

Descriptors: *Zooplankton, *Standing crop, *Reservoirs, Seasonal, Density, Rotifers, Hydrography, Physicochemical properties, Biological properties, Sampling, Copepods, Daphnia, Fish, Sunfishes, Bass.
Identifiers: *Ozarks (Ark-Mo), Beaver Reservoir, Bull Shoals Reservoir, Cladoceran communities, Entomostracans, Bosmina longirostris, Ceriodaphnia lacustris, Ceriodaphnia quadrangula, Diaphanosoma leuchtenbergianum, Chaoborus, Cladocera, Leptodora kindtii, Moina affinis, Chydorus sphaericus, Leydigia acanthocercoides, Daphnia species, Leydigia quadrangularis, Pleuroxus denticulatus, Alona, Sida, Camptocercus.

Zooplankton populations (April 1964 through June 1966) of Beaver Reservoir before full impoundment are compared with those of 14-year-old Bull Shoals Reservoir, both on the White River in Arkansas-Missouri Ozarks. Seasonal standing crop estimates show a unimodal curve in the old reservoir and a bimodal curve in the new. Significant seasonal differences between the reservoirs occurred in densities, species composition of cladoceran communities, and horizontal distribution. A decrease in Bosmina longirostris densities in 1966 accounted for differences in magnitude of spring pulses between years in Bull Shoals Reservoir. A spring 1966 increase in the standing crop in Beaver Reservoir was associated with species changes within the genus Daphnia. Mean annual standing crops of entomostracans and rotifers were similar in both impoundments. Comparison of mean annual zooplankton standing crops does not indicate abnormally high production in the new reservoir during its filling stages. The standing crop in both reservoirs is rather low in comparison with other waters. Differences in seasonal zooplankton production may have enhanced fish production in the newer reservoir. (Jones-Wisconsin)
W70-04190

WHAT'S KILLING OUR LAKES,
Minnesota Univ., Minneapolis. Dept. Soil Science.
For primary bibliographic entry see Field 02H.
W70-04193

THE UPTAKE OF ORGANIC SOLUTES IN LAKE WATER,
Uppsala Univ. (Sweden). Inst. of Limnology.
For primary bibliographic entry see Field 02H.
W70-04194

LIBERATION OF ORGANIC ACIDS BY GREEN UNICELLULAR ALGAE,
Moscow State Univ. (USSR). Dept. of Microbiology.
I. V. Maksimova, and M. N. Pimenova.
Translated from Mikrobiologiya, Vol 37, No 1, p 77-86, Jan-Feb 1969. Microbiology, Vol 38, No 1, p 64-70, 1969. 7 fig, 4 tab, 17 ref.

Descriptors: *Algae, *Chlorella, *Organic acids, Biomass, Organic compounds, Carbohydrates.
Identifiers: *Green algae, Chlorella vulgaris, Chlorella pyrenoidosa, Volatile acids, Non-volatile acids, Ketoacids, Tamiya's mineral medium, Glyoxylic acid.

An investigation of the qualitative composition of organic acids liberated to the mineral medium by different strains of Chlorella vulgaris and Chlorella pyrenoidosa. Formic, acetic, lactic, pyruvic, a-ketoglutaric, acetoacetic in some cases comprised 25% of the extracellular compound. The filtrates of the algae always contained glyoxic acid. The total quantity of acids and their representation varied with the phase of growth and size of the biomass. Analysis of cells indicated that the acids were not derived from extracellular compounds. Secretion of nonvolatile acids, gradual accumulation of volatile acids, and the sharp increase in ketoacids at high density of the culture suggested that the processes are controlled by different machanisms. (Wilde-Wisconsin)
W70-04195

SPECIAL ASPECTS OF NITROGEN FIXATION BY BLUE-GREEN ALGAE,
Bristol Univ. (England). Dept. of Botany; and Westfield Coll., London (England). Dept. of Botany.
Rosalie M. Cox, and P. Fay.
Proceedings of the Royal Society (B), Vol 172, No 1029, p 357-366, 1969. 2 fig, 3 tab, 30 ref.

Descriptors: *Nitrogen fixation, *Algae, Light, Carbon dioxide, Inhibition, Nitrogen fixing bacteria, Radioactivity technique, Photosynthesis.
Identifiers: *Anabaena cylindrica, ATP, CMU, Nitrogen-15, Pyruvate, Acetylene reduction, Reductant.

More than 90% inhibition of carbon dioxide fixation by p-chlorophenyl-1, 1-dimethylurea (CMU) failed to influence nitrogen fixation by nitrogen-starved cells of Anabaena cylindrica, but retarded the process about 50% in normal cells of the organism. This suggested that nitrogen-fixation in Anabaena is independent of reducing potential generated by the photo-electron transport, but is stimulated by photosynthetically produced carbon skeletons. Increased light augmented nitrogen-fixation in the presence and in absence of CMU thus indicating the essential part of ATP in the process. The established 3:1 ratio of pyruvate decarboxylation to nitrogen-fixation is in agreement with the hypothesis that pyruvate donates hydrogen for nitrogen reduction, and that in blue-green algae the availability of the reductant is not influenced by photosynthesis. (Wilde-Wisconsin)
W70-04249

BIOLOGICAL AND ECOLOGICAL ASPECTS OF NITROGEN FIXATION BY FREE-LIVING MICRO-ORGANISMS,
Westfield Coll., London (England). Dept. of Botany.
W. D. P. Stewart.
Proceedings Royal Society (B), Vol 172, No 1029, p 367-388, 1969. 5 fig, 1 tab, 109 ref.

Descriptors: *Nitrogen fixation, *Microorganisms, Environmental effects, Ecological distribution, Aquatic habitats, Nitrogen fixing bacteria, Actinomycetes, Yeasts, Fungi, Growth rates.
Identifiers: *Free-living microorganisms, Nitrogen transfer, Growth factors, Acetylene reduction technique.

A summary of the effect of energy sources, oxygen combined nitrogen, iron, molybdenum, and hydrogen ion concentration on nitrogen fixation by free living bacteria and blue-green algae. The section on ecological significance of free-living nitrogen-fixing microbes enumerates bacteria and blue-green algae active in frigid regions, other uplands, and aquatic habitats. The effect of these organisms on the growth of higher plants is illustrated by examples from laboratory and field trials. During the last 20 years, many nitrogen-fixing bacteria and blue-green algae were added to the original list including genera Azotobacter, Clostridium, Nostoc, and Anabaena. Nevertheless, the overall importance of nitrogen-fixation by free-living organisms on a world-wide scale cannot be assessed because of insufficiency of reliable data. This includes the often over-rated role of Azotobacter and other heterotrophic bacteria. (Wilde-Wisconsin)
W70-04250

A CRITICAL EVALUATION OF THE TROPHIC LEVEL CONCEPT. I. ECOLOGICAL EFFICIENCIES,
Wisconsin Univ., Madison. Dept. of Zoology.
For primary bibliographic entry see Field 02K.
W70-04251

A STUDY OF THE PROFUNDAL BOTTOM FAUNA OF LAKE WASHINGTON,
Washington Univ., Seattle. Dept. of Zoology.
For primary bibliographic entry see Field 02H.
W70-04253

WATER POLLUTION BY NUTRIENTS-SOURCES, EFFECTS AND CONTROL, PAPERS PRESENTED AT 1966 ANNUAL MEETING OF MINNESOTA CHAPTER SOIL CONSERVATION SOCIETY OF AMERICA.
Minnesota Univ., Minneapolis. Water Resources Research Center.
For primary bibliographic entry see Field 05B.
W70-04266

NUTRIENTS AND OTHER FORMS OF POLLUTION,
Minnesota Dept. of Conservation. Waters Section.
Gene H. Hollenstein.
Water Pollution by Nutrients--Sources, Effects and Control, Water Resources Research Center, University of Minnesota, Minneapolis, WRRC Bulletin 13, p 4-8, June 1969.

Descriptors: *Eutrophication, *Nutrients, Water pollution, Oligotrophy, Water properties, Water quality, Phosphorus, Farm wastes, Nitrogen.
Identifiers: Minnesota waters, Eutrophication control, Nutrient transport.

A brief summary of eutrophication is given. To reduce confusion between the definition of general pollution and nutrient pollution, eutrophication, the end pollution is defined as: the introduction of energy in any form into a resource which could adversely affect or destroy the resource for a particular use. Conversely eutrophication is a form of pollution defined as 'the process of enrichment of waters of lakes and streams with nutrients.' Eutrophication is a result of both natural changes and man's activities. Activities, such as sewage disposal and urbanization are enumerated and blamed for the present rapid increase in the level of eutrophication. There is no single cause or solution to eutrophication. The methods suggested to evaluate the significance and effects of possible nutrients (phosphorus, nitrogen, carbon, trace metals, potassium, silica, and vitamins) are to obtain surface and groundwater flow patterns and quality analysis, primarily on phosphorus and nitrogen entering, leaving, and retained in water bodies being studied. The major problem of eutrophication is finding methods for controlling the rate and amount of eutrophic activity without halting this process. Possible methods of nutrient control and the values

of water are listed. (See W70-04266). (Bannerman-Wisconsin)
W70-04267

DIAGNOSING POLLUTION IN LAKE MINNETONKA,
Minnesota Univ., Minneapolis. Limnological Research Center.
Robert O. Megard.
Water Pollution by Nutrients--Sources, Effects and Control, Water Resources Research Center, University of Minnesota, Minneapolis, WRRC Bulletin 13, p 9-14, June 1969. 1 fig, 1 tab, 2 ref.

Descriptors: *Phosphorus, *Nitrogen, *Algae, Sewage plants, Chlorophyll, Photosynthesis, Tributaries, Watershed management, Sediments.
Identifiers: Lake Minnetonka (Minn), Nutrient traps, Nutrient influx, Nutrient sources, Phosphorus budget, Aphanizominon flos aquae.

Increased monetary spending on waste disposal and watershed management is suggested as a recourse to deteriorating quality of lakes. An example, is widening the scope of sewage treatment to include objectives of maintaining recreational and aesthetic values of lakes as well as minimizing health hazards. Measuring abundance and daily growth of algae by chlorophyll analysis and photosynthesis experiments respectively, is a method of comparing lakes and assessing effectiveness of nutrient abatement programs. Data was gathered from Lower Lake of Lake Minnetonka adjacent to Minneapolis, Minnesota, and a direct correlation between phosphorus concentration was discovered during July and August. Each pound of phosphorus was considered responsible for 500 lbs of dry algae during the two months. Data on influx of phosphorus from tributaries and concentration in the lake indicated that sediments were the major nutrition trap. There was doubt whether phosphorus released by sediments between May and August was available to algae. Data indicated that reducing phosphorus influx by one-half would substantially control Lower Lake's eutrophication based on the assumption that a large portion of phosphorus is removed by biogeochemical process. (See W70-04266). (Bannerman-Wisconsin)
W70-04268

EFFECT OF EUTROPHICATION ON FISH AND RELATED ORGANISMS,
Minnesota Univ., St. Paul. Dept. of Entomology, Fisheries and Wildlife.
Lloyd L. Smith.
Water Pollution by Nutrients--Sources, Effects and Control, Water Resources Research Center, University of Minnesota, Minneapolis, WRRC Bulletin 13, p 15-18, June 1969.

Descriptors: *Eutrophication, *Fish harvest, *Fish, *Fish management, *Fish populations, Detritus, Decomposing organic matter, Water pollution effects, Aquatic bacteria, Oxygen, Lakes, Minnesota.
Identifiers: Desirable fish species, Algal growth, Stream oxygen levels, Oxygen depletion, Paper mill pollutants, Sphaerotilus, Walleye pike eggs.

Eutrophication is considered in the framework of fish management, excluding aesthetic considerations and views only effects on total fish populations. Before adverse levels of eutrophication eliminate certain areas from active fish production, nutrient additions increase fish biomass per acre. Often increased production will be accompanied by adverse aesthetic effects. The principal disadvantage of eutrophication to fish is lowering the oxygen supply to 5 parts per million or lower. Below 5 ppm the harvestable crop is reduced and existence of desirable deep cold water species is threatened with a shift to less desirable warm water species. Increasing amounts of hydrogen sulfide produced by decomposing beds of detritus could be lethal to fish and fish eggs. Eutrophication would increase production, while at the same time accelerate natural mortality and shift in species by high hydrogen sulfide concentrations. Long term effects of eutrophication would be increased protein production because of higher annual production of less desirable warm water fish species. (See W70-04266). (Bannerman-Wisconsin)
W70-04269

ANIMAL WASTE DISPOSAL PROBLEMS AND TRENDS IN MINNESOTA,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
Evan R. Allred.
Water Pollution by Nutrients--Sources, Effects and Control, Water Resources Research Center, University of Minnesota, Minneapolis, WRRC Bulletin 13, p 22-28, June 1969. 2 fig, 3 tab.

Descriptors: *Livestock, *Wastes, *Farm wastes, Organic wastes, Minnesota, Biochemical oxygen demand, Farms, Pollutants, Water pollution sources, Eutrophication.
Identifiers: *Livestock waste disposal, Broiler farms, Livestock wastes comparison, Feedlots, Manure production, Food production wastes, Projected livestock farms, Wastes management.

The growing problem of animal waste disposal resulting from the trend toward concentration of livestock on fewer farms is discussed. Data compiled in Minnesota indicates large percentage of these farm animals are on feed and in confinement. The problem will accelerate as herds grow larger to meet future population demands. By 1980 there is a projected 10-fold increase in the average hog and feed-cattle herd size in Minnesota. Three reasons given for failure to solve animal waste disposal problems are: (1) reluctance to monetary expenditures on adequate methods, (2) because the problem has been considered unrelated to other parts of society, and (3) approaches have been used that are only applicable to other types of waste. Cost involved and the enormity of the problem are realized when data presented indicate a 250,000 bird poultry enterprise has a biochemical oxygen demand waste equivalent to a city population of 25,000. Eutrophication is increased by spreading manure on frozen ground and the consequent runoff in spring thaw. Since the cost of a treatment plant and storage is prohibitive to individual farmers, it is concluded that no immediate, simple solution is in sight. (See W70-04266). (Bannerman-Wisconsin)
W70-04270

MANAGING LIVESTOCK WASTES TO CONTROL POLLUTION,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
James A. Moore.
Water Pollution by Nutrients--Sources, Effects and Control, Water Resources Research Center, University of Minnesota, Minneapolis, WRRC Bulletin 13, p 29-34, June 1969. 2 tab.

Descriptors: *Pollution control, *Organic loading, *Cattle, *Hogs, *Sheep, *Farm wastes, Water pollution sources, Water quality, Waste disposal, Minnesota, Nitrogen, Phosphorus, Potassium, Aerobic treatment, Water pollution control.
Identifiers: *Manure processing, *Manure disposal, Livestock industry, Manure storage, Oxidation ditch.

High costs and larger quantities of inert and biologically stable materials prohibit many municipal waste treatment systems being used for animal waste disposal. No system has been designed to remove nitrogen and phosphorus in animal wastes. Four steps in the management of manure are suggested: (1) collection, (2) processing, (3) storage, (4) utilization or disposal. Drying manure simplifies sanitation problems because it is stable, relatively odorless, and breeds few flies. Energy required for drying limits method. Anaerobic lagoons are a popular method for stabilizing organic matter, because disposal problems are mostly eliminated. Animal waste can be treated in aerobic oxidation ponds with oxygen supplied by algae and natural reaeration supplemented by mechanical aeration. Impervious-bottom tanks and storage areas should be considered to prevent nutrient leaching during extended holding periods. Although economically non-competitive, more effort to dispose animal waste as fertilizer would alleviate the problem and prove beneficial to soils. (See W70-04266). (Bannerman-Wisconsin)
W70-04271

RUNOFF AND SEDIMENT AS NUTRIENT SOURCES,
Agricultural Research Service, Morris, Minn. North Central Soil Conservation Research Center.
Robert F. Holt.
Water Pollution by Nutrients--Sources, Effects and Control, Water Resources Research Center, University of Minnesota, Minneapolis, WRRC Bulletin 13, p 35-38, June 1969. 3 tab, 3 ref.

Descriptors: *Surface runoff, *Sediments, *Nutrient sources, Phosphorus, Nitrogen, Minnesota, Lakes, Nutrients, Snowmelt, Sediment load, Agronomic crops, Forages.
Identifiers: Barnes soil, Corn crops, Oats crops, Hay crops, Fallow land, Cropping treatments, Alfalfa plants.

Amounts of nitrogen and phosphorus added to surface waters by runoff depend upon soil texture, vegetation, organic residue, and management practices. Runoff contribution to sediment fertility is based on soil, topography, and vegetation. Data provided indicate large quantities of phosphorus are removed from surface water by sediments. Although sediment contribution to soluble nutrient leach is not known, sediments are not believed to release significant amounts of soluble phosphorus. Data supplied qualifies agricultural runoff as a major contributor of nutrients to surface waters. Crop type and farming techniques influence quantities of phosphorus and nitrogen contributed by runoff. Alfalfa plots contribute the greatest quantities of soluble phosphorus during snowmelt runoff. In most cases eutrophication is regarded as an irreversable process because it is a natural phenomena. (See W70-04266). (Bannerman-Wisconsin)
W70-04272

CONTROLLING NUTRIENTS AND ORGANIC TOXICANTS IN RUNOFF,
Minnesota Univ., Minneapolis. Dept. of Soil Science.
William P. Martin.
Water Pollution by Nutrients--Sources, Effects and Control, Water Resources Research Center, University of Minnesota, Minneapolis, WRRC Bulletin 13, p 39-47, June 1969. 15 ref.

Descriptors: *Waste water disposal, *Sediments, *Nutrients, *Surface runoff, Groundwater, Erosion, Agricultural watersheds, Minnesota, Lagoons, Waste dilution, Waste disposal, Waste water disposal, Soil properties, Nitrogen, Phosphorus.
Identifiers: Recharge basins, Organic toxicants, Agricultural pollution, Minnesota Soil Survey, Waste spray irrigation, Land waste disposal, Agricultural wastes pollutants, Waste disposal systems.

Increased numbers of soil surveys are essential to each land use decision, specifically in land waste disposal. Leaching, erosion, and groundwater contamination are minimized when suitable soils are chosen for specific uses, such as feedlots. Waste disposal has been practiced without regard for location, which can result in severe contamination in sandy soils that safely accommodate only 100 lbs of nitrogen/acre per growing season. When organic food sources are available, the microbial population of soil is able to decompose almost any amount of organic material introduced. Large quantities of organic materials could be disposed without harming the environment. Nitrate contamination in aerated soils is a serious problem and results from nitrifying bacteria oxidizing ammonia released

from ammonification. Denitrifying bacterial will reduce nitrate concentration under anaerobic conditions. Growing plants will also reduce nitrate concentration. Nitrogen influx into groundwater is reduced by holding lagoons or rotation spreading. Phosphorus is easily fixed in the soil and is not considered a problem. Several successful land waste disposal systems, such as using recharge basins, are discussed. (See W70-04266). (Bannerman-Wisconsin)
W70-04273

TREATMENT OF MUNICIPAL WASTES,
Minnesota Univ., Minneapolis. Dept. of Civil Engineering.
Walter K. Johnson.
Water Pollution by Nutrients--Sources, Effects and Control, Water Resources Research Center, University of Minnesota, Minneapolis, WRRC Bulletin 13, p 48-52, June 1969. 2 fig, 1 tab.

Descriptors: *Waste treatment, *Domestic wastes, *Municipal wastes, Wastes, Phosphorus, Nitrogen, Industrial wastes, Infiltration, Denitrification, Chemical precipitation, Biological treatment, Ion exchange, Filtration, Adsorption, Reverse osmosis.
Identifiers: Diurnal concentrations, Commercial wastes, Ammonia stripping.

Limited assimilative capacity of receiving waters restricts the municipal effluent flow allowable before pollution becomes a problem. With increasing population, larger volumes of flow are inevitable, demanding upgrading of wastewater treatment as a pollution preventative. Technology to improve treatment is emphasized as being available, but what is needed now are human and financial resources. Four sources of municipal wastes are discussed: domestic, commercial, industrial, and infiltration. Removing solids from dilute waste water is a major processing problem. Average flow is 120 gallons per day per person. After primary and secondary treatment, which are physical and biological process respectively, comes the removal of nutrients by tertiary treatment. With technology available for all three treatments, municipalities could have a closed water system. For general removal of solids in tertiary treatment the processes of filtration, adsorption, and reverse osmosis are suggested. (See W70-04266). (Bannerman-Wisconsin)
W70-04274

SEPTIC TANK EFFLUENTS,
Minnesota Univ., Minneapolis. Dept. of Civil Engineering.
Robert C. Polta.
Water Pollution by Nutrients--Sources, Effects and Control, Water Resources Research Center, University of Minnesota, Minneapolis, WRRC Bulletin 13, p 53-57, June 1969. 1 fig.

Descriptors: *Septic tanks, *Effluents, Groundwater, Nitrification, Nitrogen, Phosphorus, Absorption, Soil types, Ammonia, Wells, Water pollution sources.
Identifiers: Groundwater contaminants, Phosphorus fixation.

Septic tanks are a potential source of nitrogen and phosphorus contamination due to effluent discharge by means of tile fields and seepage pits. Groundwater can then pollute surface water by direct flow or indirectly, by pumping and subsequent surface discharge. Many soils reduce possible phosphorus contamination by their tremendous phosphorus fixing ability. Fixation processes include adsorption, mineral crystal structure may be changed by replacement reaction, and formation of insoluble phosphorus compounds and subsequent precipitation. Fixation can remove as much as 8000 lbs phosphorus/acre to a depth of 6 inches. Extent of nitrogen flow in groundwater is affected by adsorption-ion exchange phenomena exhibited by soils, and action of nitrifying and denitrifying bacteria. Since most nitrogen is ammonia, as much as 10 milligrams nitrogen/100 grams can be adsorbed by basic, negatively charged soils. Nitrogen mobility is increased by nitrifying bacteria converting nitrogen compounds to nitrates, which is not adsorbed. At the present there is no practicable method to limit nitrification. Although phosphorus is not a serious threat, nitrogen groundwater contamination has been found considerable distances from the source. Eutrophication and methemoglobinemia could result from groundwater nitrogen. (See W70-04266) (Bannerman-Wisconsin)
W70-04275

WATER POLLUTION IN RECREATIONAL AREAS--SOURCES AND CONTROL,
Forest Service (USDA), Ely, Minn. Superior National Forest.
Michael A. Barton.
Water Pollution by Nutrients--Sources, Effects and Control, Water Resources Research Center, University of Minnesota, Minneapolis, WRRC Bulletin 13, p 58-63, June 1969. 1 tab, 7 ref.

Descriptors: *Water pollution sources, *Water pollution control, *Waste disposal, Minnesota, Clearcutting, Recreation wastes.
Identifiers: Silvicultural practices, Herbiciding, Honeywagons.

Although water pollution is not severe in recreational areas, demand for high water quality necessitates pollution control. Prevention programs are emphasized as more promising and less costly than correction programs. Primary water pollution problem in recreational areas is nutrient enrichment, which is surprisingly high, because visitors concentrate in small areas compared to total park area. Another significant nutrient source is water inflow from municipalities. Disposal is a special problem in wilderness areas. Nutrient export by airplane and helicopter 'honeywagons', or combustion toilets have been suggested. Oil from outboard motors exerts an oxygen demand. Silviculture practices of clearcutting and herbiciding can increase stream nitrogen concentration 20 times. Natural input of nutrient from soils and vegetation in the watershed are verified as significant sources by given data. Establishing monitoring system of physical, chemical, and biological parameters is suggested to measure effectiveness of control measures. (See W70-04266). (Bannerman-Wisconsin)
W70-04276

THE USE OF A DEEP TANK IN PLANKTON ECOLOGY. I. STUDIES OF THE GROWTH AND COMPOSITION OF PHYTOPLANKTON CROPS AT LOW NUTRIENT LEVELS,
California Univ., San Diego, La Jolla. Inst. of Marine Resources.
J. D. H. Strickland, O. Holm-Hansen, R. W. Eppley, and R. J. Linn.
Limnology and Oceanography, Vol 14, No 1, p 23-34, 1969. 9 fig, 4 tab, 17 ref.

Descriptors: *Plankton, *Laboratory tests, *Ammonia, *Nitrate, Silica, Proteins, Carbohydrates, Phosphorus, Lipids, Chlorophyll, Phytoplankton, Nutrient requirements.
Identifiers: Phytoplankton growth, Phytoplankton composition, Nutrient levels, Ditylum brightwellii, Cachonina nici, Gonyaulax polyedra, Phaeocystis, DNA, ATP, Chlorophyll a, Chlorophyll c.

A cylindrical tank, 3 meters in diameter and 10 meters tall, was used to grow phytoplankton crops under simulated natural conditions of nutrient concentration and cell density. Construction and operation of the tank are described. Three, two-week, growth experiments were performed using Ditylum brightwellii (a centric diatom), Cachonina nici (an armored dinoflagellate), with a mixed crop of the dinoflagellate Gonyaulax polyedra and Phaeocystis (a colonial member of Haptophyceae). In each experiment the chemical composition of the tank-grown cultures were analysed for cell carbon, nitrogen, phosphorus, lipid, carbohydrate, DNA, ATP, chlorophyll a, and carotenoids. Successful nitrogen budgets were achieved with D brightwellii and C nici. Nearly all the ammonia was used before any nitrate was assimilated. With D brightwellii, there was a marked increase in chlorophyll, phosphorus, and ATP contents when the cells switched from ammonia to nitrate. Lipid content increased nearly twofold in nitrate-grown cells. Unlike the behavior found with D brightwellii, the cells of C nici grown on nitrate had approximately equal values of lipid, chlorophyll, phosphorus, and ATP as cells grown on ammonia. Carbohydrate contents, however, increased sixfold in nitrogen-starved cells. Upon addition of nitrate the concentration of carbohydrates decreased appreciably. (Haskins-Wisconsin)
W70-04278

THE KINETICS OF NITRATE AND AMMONIA UPTAKE BY NATURAL POPULATIONS OF MARINE PHYTOPLANKTON,
Washington Univ., Seattle. Dept. of Oceanography.
J. J. MacIssaac, and R. C. Dugdale.
Deep-Sea Research, Vol 16, p 45-57, 1969. 8 fig, 3 tab, 17 ref.

Descriptors: *Kinetics, *Nitrates, *Ammonia, *Population, *Marine plants, *Phytoplankton, Tracers, Alaska, Pacific Ocean, Enzymes, Nutrients, Productivity, Oligotrophy, Eutrophication, California, Gulfs, Spectrometers, Sampling, Nitrites, Radioisotopes, Detritus, Light intensity, Depth, Mexico, Velocity, Incubation, Silicates, Phosphates, Vitamin B, Trace elements, Iron, Growth rates, Tropical regions.
Identifiers: *Uptake, Nitrogen-15, Bering Sea (Alaska), Michaelis-Menten equation, Stephen's Passage (Alaska), Particulate, Costa Rica, Nutrient concentration, Cyclotella nana, Phaedactylum tricornutum, Euphotic zone.

Natural marine phytoplankton populations response to nitrate and ammonia concentrations has been investigated using nitrogen-15 tracer techniques. Bering Sea, waters off southeastern Alaska, and northeastern tropical Pacific experiments suggest that uptake of both compounds follows the Michaelis-Menten expression for enzyme kinetics. A hyperbola describes the relationship between the concentration of nitrate or ammonia and uptake of that nutrient. Such a hyperbola can be obtained in experiments with ammonia and, under suitable conditions, with nitrate. The value of K-sub-t, nutrient concentration at which the maximum uptake rate is reduced by 1/2, is related to the nutrient and productivity regime of the region inhabited by the population. In the tropical oligotrophic area investigated, K-sub-t nitrate is less than 0.2 micrograms atoms/liter, while in corresponding eutrophic regions, K-sub-t nitrate exceeds 1.0 micrograms atoms/liter. These values suggest that phytoplankton populations of oligotrophic regions are adapted to low ambient nutrient concentrations and are able to take up nutrients at a higher rate under these conditions than would phytoplankton species characteristic of eutrophic conditions and showing a higher K-sub-t value. (Jones-Wisconsin)
W70-04279

STUDY OF BACTERIA ASSOCIATED WITH MARINE ALGAE IN CULTURE. I. PRELIMINARY DETERMINATION OF SPECIES (FRENCH),
Station Marine d'Endoume, Marseille (France).
For primary bibliographic entry see Field 02H.
W70-04280

TOXICITY AND ENVIRONMENTAL REQUIREMENTS OF A STRAIN OF APHANIZOMENON FLOS-AQUAE (L) RALFS,
National Marine Water Quality Lab., West Kingston, R.I.
John H. Gentile, and Thomas E. Maloney.
Canadian Journal of Microbiology, Vol 15, No 2, p 165-173, 1969. 7 fig, 2 tab, 25 ref.

Descriptors: *Toxicity, *Nutrient requirements, *Cyanophyta, *Environment, Nitrogen fixation, Hydrogen ion concentration, Growth rates, Temperature, Phosphorus, Age, Light intensity, Assay, Fish, Crustaceans, Daphnia, Copepods, Killifishes, Dissolved oxygen, Bacteria, Cytological studies, Biochemistry, Spores, Carbon radioisotopes, Bicarbonates, Incubation, Shiners, Copper sulfate.
Identifiers: *Aphanizomenon flos-aquae (L) Ralfs, Tris, Fundulus heteroclitus, Cyprinodon variegatus, White mice, Notemigonus crysoleucas, Bosmina longirostris, Daphnia catawba, Ostracods, Chydorid cladocerans, Microcrustaceans, Microcystis aeruginosa, Anabaena flos-aquae, Gloeotrichia ecinulata, Nitzschia, Endotoxin, Contaminants, Algal bloom.

A toxic strain of Aphanizomenon flos-aquae was isolated and cultured in a defined medium (ASM-1). This strain fixes nitrogen, has pH optimum of 7.5 and maximum growth rates at 5000 lux and 26C. Phosphorus levels of 1.0 micromoles readily supported populations of 100,000 cells/milliliter with growth stimulation evident at concentration of 0.1 micromoles phosphorus. Tris is inhibitory to growth at concentrations above 2.5 micromoles. Toxin production is related to culture age, temperature, and light intensity but not nitrogen source. Intraperitoneal injection of toxic extracts into Fundulus heteroclitus, Cyprinodon variegatus, and white mice gave a LD (100%) of 0.5 milligrams/kilogram, 0.5 milligrams/kilogram, and 8 milligrams/kilogram, respectively. Assays with Notemigonus crysoleucas and Bosmina longirostris indicate that toxin from naturally occurring bloom populations (1,000,000 cells/milliliter) if total released simultaneously, could kill certain fish species and microcrustaceans. Daphnia catawba was more toxin resistant (LD (100%) equals 1.0 milligrams/milliliter) while cyclopod copepods, ostracods, and chydorid cladocerans were unaffected by toxin concentrations of 2.0 milligrams/milliliter. Ecological significance of this toxic alga in relation to fish kills is discussed. (Jones-Wisconsin)
W70-04282

PHYTOPLANKTON AND RELATED WATER-QUALITY CONDITIONS IN AN ENRICHED ESTUARY,
Geological Survey, Tacoma, Wash.
For primary bibliographic entry see Field 02L.
W70-04283

COMPETITION BETWEEN PLANKTONIC BACTERIA AND ALGAE FOR ORGANIC SOLUTES,
Uppsala Univ. (Sweden). Inst. of Limnology.
For primary bibliographic entry see Field 02H.
W70-04284

A NEW METHOD FOR THE STUDY OF BACTERIA IN LAKES: DESCRIPTION AND RESULTS,
North Carolina State Univ., Raleigh. Dept. of Zoology; and Gordon Coll., Wenham, Mass.
For primary bibliographic entry see Field 02H.
W70-04287

ANNUAL AUTOTROPHIC PRODUCTION OF PHYTOPLANKTON IN LAKE BAIKAL,
For primary bibliographic entry see Field 02H.
W70-04290

STUDIES OF A SIMPLE LABORATORY MICROECOSYSTEM: BACTERIAL ACTIVITIES IN A HETEROTROPHIC SUCCESSION,
Georgia Univ., Athens, Dept. of Microbiology; and Georgia Univ., Athens. Dept. of Zoology.
Robert W. Gordon, R. J. Beyers, E. P. Odum, and R. G. Eagon.
Ecology, Vol 50, No 1, p 86-100, 1969. 8 fig, 12 tab, 54 ref.

Descriptors: *Laboratories, *Ecosystems, *Bacteria, Aquatic microorganisms, Chlorella, Vitamin B, Carbon dioxide, Nitrogen, Primary productivity, Decomposing organic matter, Photosynthesis, Respiration, Biomass, Biological communities, Metabolism, Carbon radioisotopes, Sewage, Texas, Biochemistry, Electron microscopy, Pseudomonas, Enzymes, Fungi, Organic matter, Lactobacillus, Spectrophotometry, Chromatography, Scenedesmus, Depth, Stratification.
Identifiers: *Heterotrophic succession, Excretions, Dissolved carbon, Particulate, Microcosm, Austin (Tex), Flagellates, Heterotrophic, Ostracods, Xanthomonas, Bacillus, Chromogenic characteristics, Species diversity, Glyoxylate, Radioautography, Optical density, Growth factors, Schizothrix calciocola, Paramecium bursaria, Lepadella.

Eleven species or functional types of heterotrophic bacteria were isolated during study of heterotrophic succession in an aquatic microcosm. Bacterial population numbers and dominant types changed rapidly. Dominant primary producer, Chlorella, depended upon thiamin supplied by five bacterial isolates. Bacteria were functional contributors of thiamin, carbon dioxide, and possibly nitrogen sources to primary producers; as primary consumers of algal excretions; as secondary consumers of bacterial excretions; as decomposers. During succession net photosynthesis surpassed night respiration from day 5 through 45; as maturity approached the photosynthesis respiration ratio fluctuated around 1. Dissolved carbon was present at 240 milligrams/liter at zero time and decreased owing to heterotrophic activity of 0.0000000015 bacterial cells/milliliter by day 8 and maintained at approximately 20.7 milligrams carbon/liter from day 8 through maturity. Particulate biomass increased steadily until day 50; no further increase followed. Bimodal pattern showed in bacterial numbers, Chlorella numbers, community metabolism, carbon-14-U glyoxylate uptake and bacterial species diversity. Peaks appeared early and late in succession with mid-succession decrease in activity. The microcosm exhibited trends expected of larger, more open, developing ecosystems. Methods are useful tools for examining ecological principles. (Jones-Wisconsin)
W70-04291

THE RIGHT TO A CLEAN ENVIRONMENT,
Mount Sinai School of Medicine, New York. Dept. of Community Medicine.
Eric J. Cassell.
Archives of Environmental Health, Vol 18, p 839-843, 1969.

Descriptors: *Air pollution, *Air pollution effects, *Mortality, Population, Public health, Sulfides, Environmental effects.
Identifiers: *Sulfur dioxide, Catalytic metals, Donora (Pa), London, Synergism, New Florence (Pa), Seward (Pa).

Research in air pollution was stimulated by the death of 22 persons in Donora, a Pennsylvania town of 14,000, and the illness of about half that population. The toxic substances, ranging from sulfur dioxide to hydrocarbons, caused eye irritation, chronic bronchitis, and increased mortality. The 1952 London air pollution episode produced some 4,000 deaths above normal in two weeks. The ill effects of sulfur dioxide appear to materialize only when air contains some particulate matter or catalyzing particles that convert sulfur dioxide to sulfuric acid. Gasoline, plastic bags, transistors, food packaging, building materials, drugs, and endless other substances carry copper, nickel, vanadium, titanium, boron, barium, and numerous other catalytic metals which end their life in the air via incinerators. (Wilde-Wisconsin)
W70-04292

THE NATIONAL ESTUARINE POLLUTION STUDY - VOLUME I.
Federal Water Pollution Control Administration, Washington, D.C.
Federal Water Pollution Control Administration Report to Congress, Nov 3, 1969. 130 p, 3 fig.

Descriptors: *Estuaries, *Water resources development, *Water management (Applied), *Environmental effects, *Water pollution control, Surveys, Environmental sanitation, Water pollution effects, Regulation, Waste disposal, Sewage treatment, Water pollution sources, Recreation, Fishing, Transportation, Economics, Social aspects.
Identifiers: Estuarine resources management.

Existing pertinent information on estuarine environments is assembled, coordinated, and organized, and additional investiations and surveys were carried out to supplement existing information. Not only are recommendations made for a national program, but also an analysis of the importance of estuaries in the economic and social environment and the effects of pollution on the natural ecosystem is given. Major economic, social, and ecological trends were examined to show what the future might hold; and recommendations are made for research and study to acquire basic knowledge needed to manage future trends. The recommended national program is based on institutional management with multiple long-term use as a common denominator. Formation of the organizations to accomplish this and the active implementation of these recommendations will permit maximum use of the entire estuarine zone while preserving it for the benefit of future generations. (Knapp-USGS)
W70-04299

THE NATIONAL ESTUARINE POLLUTION STUDY - VOLUME II.
Federal Water Pollution Control Administration, Washington, D.C.

Federal Water Pollution Control Administration Report to the Congress, Nov 3, 1969. 575 p, 38 ref.

Descriptors: *Estuaries, *Water resources development, *Water management (Applied), *Environmental effects, *Water pollution control, Surveys, Environmental sanitation, Water pollution effects, Regulation, Waste disposal, Sewage treatment, Water pollution sources, Recreation, Fishing, Transportation, Economics, Social aspects.
Identifiers: Estuarine pollution.

The existing relationship between the biophysical environment and the socioeconomic environment in the estuarine zone of the U.S. is described. The estuarine zones before man's use as well as the uses of the estuarine zone and their effects on the land, the water, and the life are discussed. What will happen to the estuarine zone unless man controls his impact on this part of his environment is shown. The biophysical environment divides naturally into ten geographical regions, each dominated by a different combination of environmental conditions. The discussion revolves about these biophysical regions as the primary subdivisions of the natural environment of the estuarine zone. Because of the similarity of environmental conditions within it, each region has estuarine systems, uses, and problems which are typical of the region, if not unique to it. The essential unity of the estuarine zone as a unique resource is emphasized because an effective national management program needs to use knowledge gained in one region to solve problems in the others. (Knapp-USGS)
W70-04300

THE NATIONAL ESTUARINE POLLUTION STUDY - VOLUME III.
Federal Water Pollution Control Administration, Washington, D.C.

Federal Water Pollution Control Administration Report to the Congress, Nov 3, 1969. 640 p, 8 fig, 33 tab, 31 ref.

Descriptors: *Estuaries, *Water resources development, *Water management (Applied), *Environmental effects, *Water pollution control, Surveys,

Environmental sanitation, Water pollution effects, Regulation, Waste disposal, Sewage treatment, Water pollution sources, Recreation, Fishing, Transportation, Economics, Social aspects.
Identifiers: Estuarine resources management.

Background material is compiled for the National Estuarine Pollution Study. To provide a basis for developing recommendations and defining responsibilities, a volume of material was amassed on the views, suggestions, programs, and legislative authorities of all sectors of the National community -- Federal, State, and local governments, and public and private interests. The resulting material consists of reports, correspondence, and personal communications which were analyzed and summarized to produce relatively brief overviews. The organizations include Federal agencies, State agencies, local governments, compact (or interstate) agencies, and public and private interests. These overviews were related to those of other marine resource studies and then related to specific geographic areas to present a concrete overall view, and finally summarized in the form of Conclusions. A skeletal outline is provided for the development of recommendations. Guidelines are suggested for a management statute. (Knapp-USGS)
W70-04301

THE IMPACT OF MINE DRAINAGE POLLUTION ON INDUSTRIAL WATER USERS IN APPALACHIA,
Battelle Memorial Inst., Columbus, Ohio.
For primary bibliographic entry see Field 05G.
W70-04329

THE IMPACTS OF MINE DRAINAGE POLLUTION ON LOCATION DECISIONS OF MANUFACTURING INDUSTRY IN APPALACHIA.
Fanus Co., Inc., New York.
For primary bibliographic entry see Field 05G.
W70-04332

IMPACT OF MINE DRAINAGE ON RECREATION AND STREAM ECOLOGY: APPENDIX E. MINE DRAINAGE POLLUTION AND RECREATION IN APPALACHIA.
Nathan (Robert R.) Associates, Inc., Washington, D.C.
For primary bibliographic entry see Field 05G.
W70-04333

EFFECT OF INDUSTRIAL EFFLUENT ON WATER QUALITY OF LITTLE SIX MILE CREEK NEAR JACKSONVILLE, FLORIDA,
Geological Survey, Ocala, Fla.
Donald A. Goolsby.
Available from Superintendent of Documents, U S Government Printing Office, Washington, D C 20402 - Price $3.75 per copy. Geological Survey Research 1969, Professional Paper 650-D, p D240-D243, 1969. 4 p, 4 fig, 1 tab, 1 ref.

Descriptors: *Water pollution effects, *Acidic water, *industrial wastes, *Florida, Water quality, Data collections, Sampling, Monitoring, Acidity, Dissolved oxygen, Solutes.
Identifiers: Jacksonville (Fla).

A reconnaissance of Little Six Mile Creek near Jacksonville, Fla., made August 24-26, 1965, showed that acid industrial effluent has severely affected the entire stream, and during low flow, the upper Ribault River. The total acid load of the effluent during this reconnaissance was equivalent to 1.7 tons per day as sulfuric acid and the dissolved-iron load was equivalent to 0.4 ton per day. At times the acid effluent is neutralized by alkaline effluent from a tributary stream. (Knapp-USGS)
W70-04344

THE RATE OF LIBERATION OF PHOSPHATE IN SEA WATER BY THE BREAKDOWN OF PLANKTON ORGANISMS,
Marine Biological Association of the United Kingdom, Plymouth (England). Lab.
L. H. N. Cooper.
Journal of the Marine Biological Association of the United Kingdom, Vol 20, p 197-200, 1941. 1 fig, 1 tab, 6 ref.

Descriptors: *Phosphates, *Sea water, *Plankton, Zooplankton, Phytoplankton, Time, Diatoms, Sampling.
Identifiers: *Phosphate liberation, *Inorganic phosphate, Phosphate-phosphorus breakdown, Calanus, Acartia, Temora, Ctenophores, Rhizosolenia, Skeletonema costatum, Guinardia flaccida.

Four experiments were made to determine the rate inorganic phosphate is set free from plankton. Samples of animal and plant plankton caught in fine and very fine silk tow-nets were analyzed for phosphorus, and aliquot parts filtered on a silk disc. They were added to sea water in glass vessels and subsequent changes in the phosphate content of water followed. Breakdown of zooplankton was very rapid and more phosphate was released than the original addition as plankton. The balance was produced from dissolved organic phosphorus compounds in the water. Breakdown of phytoplankton showed a short time lag and only a portion of phosphorus added was freed as phosphate. An inflection in the curves was noted after 15-20 days' storage. Rate of liberation slowed and accelerated again before reaching the maximum. A slow fall in phosphate occurred during the four months after the maximum had been reached; no explanation is apparent for this, although molds may be involved. Experimental waters were much richer in plankton than sea water ever is, thus presumably, all processes of decay were greatly accelerated, compared with natural conditions. (Jones-Wisconsin)
W70-04366

ECOLOGY AND CHARACTERIZATION OF YEASTS FROM AQUATIC REGIONS OF SOUTH FLORIDA,
Miami Univ., Fla. Dept. of Microbiology; and Miami Univ., Fla. Inst. of Marine Sciences.
D. G. Ahearn, F. J. Roth, Jr., and S. P. Meyers.
Marine Biology, Vol 1, No 4, p 291-308, June 1968. 9 fig, 7 tab, 36 ref.

Descriptors: *Ecology, *Yeasts, *Florida, *Aquatic environments, Fresh water, Salinity, Bioindicators, Fungi, Habitats, Sampling, Estuaries, Systematics, Sea water, Hydrogen ion concentration, Molds.
Identifiers: *South Florida waters, Miami (Fla), Everglades (Fla), Lake Okeechobee (Fla), Candida, Physiological charactertistics, Saccharomyces fructuum, Debaryomyces hansenii, Cryptococcus laurentii, Cryptococcus albidus, Rhodotorula, Torulopsis glabrata, Torulopsis ernobii, Hansenula anomala, Pichia, Trichosporon cutaneum, Kluyveromyces aestuarii, Sporobolomyces, Spirodela, Ascosporogenous, Asporogenous, Morphological.

The composite aquatic regions of southern Florida and adjacent areas were the site of mycological investigations based on more than 1000 yeasts collected and exceeding 50 representative taxa. Highest yeast densities were found in fresh waters with the recovery of yeasts per sample decreasing from 100% to approximately 70% with lowered organic content, increasing salinity and remoteness from land. Average cell population densities, species, variety, and particularly the number of sexual yeasts, decreased in saline samples. The isolation media used were evaluated and discussed in terms of yeast densities obtained. Strictly oxidative species of Candida, Cryptococcus, and Rhodotorula and the sexual yeast, Debaryomyces hansenii, were widespread in all the habitats studied and predominated in water of relatively low organic content. Selective survival of certain yeasts in various aquatic environments is suggested. Definite distributional patterns were exhibited by various taxa and the possible existence of 'indicator' species is indicated. Systematics of fungi are reviewed at length and the significance of strain differences considered and discussed, as related to the unique characteristics of the various ecological habitats. (Jones-Wisconsin)
W70-04367

YEASTS FROM THE NORTH SEA,
Miami Univ., Fla. Inst. of Marine Sciences; Miami Univ., Fla. Dept. of Microbiology; and Biologische Anstalt Helgoland (West Germany).
S. P. Meyers, D. G. Ahearn, W. Gunkel, and F. J. Roth, Jr.
Marine Biology, Vol 1, No 2, p 118-123, 1967. 6 fig, 1 tab, 19 ref.

Descriptors: *Yeasts, Population, Marine plants, Dinoflagellates, Oceans, Bioindicators, Fungi, Estuaries, Bacteria, Sampling, Seasonal, Hydrography, Florida, Thermocline, Currents (Water), Phytoplankton, Zooplankton, Hydrogen ion concentration, Algae.
Identifiers: *North Sea, Mycota, Debaryomyces hansenii, Rhodotorula rubra, Candida diddensii, Candida zeylanoides, Candida krusei, Candida obtusa, Candida tropicalis, Noctiluca miliaris, Helgoland (Germany), Aureobasidium pullulans, Hanseniaspora uvarum, Radulespores, Zymological, Elbe (Germany), Sporobolomyces roseus, Autolysis, Ascosporogenous.

Mycological examination of estuarine and open ocean environments have revealed diverse populations of yeast of various taxa and physiological groups. Evidence indicates that these microorganisms are normal components of ocean biota, and that certain species may serve as bio-indicators for specific water masses and conditions. Data are needed on the mycota associated with algal 'blooms' and their effect on growth stimulation and reproduction of fungi. Yeasts were isolated from twelve established sites in the North Sea from 1964 to 1966. A percentage frequency of 99% with populations varying from less than 10 to more than 3000 viable cells/liter was observed. This mycota was characterized by considerable spatial and temporal fluctuations, with the dominant yeast present the ascosporogenous species, Debaryomyces hansenii. This taxon, as well as other common North Sea yeasts, Rhodotorula rubra and Candida diddensii, have been reported frequently from other marine locales. Noteworthy concentrations of yeasts, especially D hansenii, were observed during summer, often in association with various stages of development of the dinoflagellate, Noctiluca miliaris. Population dynamics of the North Sea yeasts are discussed in relation to similar studies of other marine environments. (Jones-Wisconsin)
W70-04368

THE PHYSIOLOGY OF AN ALGAL NUISANCE,
Westfield Coll., London (England). Dept. of Botany.
G. E. Fogg.
Proceedings Royal Society B, Vol 173, p 175-189, 1969. 4 fig, 84 ref.

Descriptors: *Nuisance algae, Cyanophyta, Vitamins, Peptides, Organic matter, Trace elements, Light intensity, Chlamydomonas, Chlorella, Enzymes, Carbon dioxide, Growth rates, Plankton, Oxygen, Nitrogen fixation, Nitrates, Electron microscopy, Ammonia, Spectrometers, Diffusion, Turbulence, Toxins, Bacteria, Copper sulfate, Circulation.
Identifiers: *Physiology, Spirogyra, Myxophyceae, Microcystis, Coelosphaerium, Oscillatoria, Anabaena, Aphanizomenon, Gloeotrichia, Polypeptides, Photoassimilation, Berkelse Lake (Netherlands), Heterocysts, Gas-vacuoles, Llangors Lake (Wales), Halobacterium, Respirometer, Protoplasm, Water-blooms, Lake George (Uganda), Rhine-Meeuse delta (Netherlands), Hohlspindeln, Myxophycean blooms.

Physiology of Microcystis, Coelosphaerium, Oscillatoria, Anabaena, Aphanizomenon, and Gloeotrichia are discussed relative to development of blooms. Since the algae form gelatinous masses, local exhaustion of ammonia may force cells to utilize the nitrogen molecule, aggravating eutrophication. Remarkable features of the planktonic blue-green algae are cells containing gas-vacuoles. These gas-filled cavities in protoplasm appear as indefinite, irregular, refractive bodies. The relatively high buoyant density of their membranes shows them as probably at variance to other cellular membranes. They are specific structures with definite selective value. Perhaps gas-vacuole formation in dim light causes a cell or colony to rise; inhibition of gas-vacuole formation, and continued growth and cell division nearer the surface subsequently causing it to become heavier and sinking. This up and down movement would contribute to maximum absorption of mineral nutrients. Near the surface light inhibition of photosynthesis may result in inability to 'dilute out' the gas-vacuoles by growth, thus the alga remains floating and becomes moribund. Copper sulphate usage for control of myxophycean water-blooms is questionable. Inhibiting formation of these gas-vacuoles or their destruction by ultrasonic radiation, or other means, might effectively control the nuisance. Artificial circulation may break down chemical stratification in the water. (Jones-Wisconsin)
W70-04369

PERIPHYTON GROWTH ON ARTIFICIAL SUBSTRATES IN A RADIOACTIVELY CONTAMINATED LAKE,
Oak Ridge National Lab., Tenn. Radiation Ecology Section.
Ernest C. Neal, Bernard C. Patten, and Charles E. DePoe.
Ecology, Vol 48, No 6, p 918-924, 1967. 1 fig, 1 tab, 17 ref.

Descriptors: *Periphyton, *Radioactivity, *Lakes, Productivity, Radioisotopes, Temperature, Depth, Bacteria, Slime, Algae, Cyanophyta, Diatoms, Chlorophyta, Light intensity, Succession, Zinc radioisotopes, Cesium, Cobalt radioisotopes, Seasonal, Radiochemical analysis, Monitoring, Pigments, Phytoplankton, Waste water (Pollution), Photosynthesis, Chlamydomonas, Chlorella, Euglena, Scenedesmus, Protozoa, Nematodes, Surfaces.
Identifiers: *Growth dynamics, *Bacterial colonization, *Artificial substrates, *Radionuclide accumulation, Ruthenium-106, White Oak Lake (Tenn), Activity-density, Vertical, Microcystis, Oscillatoria, Navicula, Cymbella, Lyngbya, Fragilaria, Oedogonium, Spirogyra, Chaetophora, Stigeoclonium, Ankistrodesmus, Aphanocapsa, Chroococcus, Closterium, Gleocapsa, Spirulina, Ulothrix, Chironomids, Melton Hill Dam (Tenn), Cobalamin.

Periphyton colonization, biomass development and radionuclide accumulation were studied by suspending polyethylene tape vertically for periods to 9 weeks in a radioactively contaminated lake. Biomass growth was nearly complete on upper tape sections after 2 weeks, but full development on lower sections took longer; maximum biomass occurred at 25.4 to 50.8 centimeters depth. Blue-greens were initial algal dominants, succeeded by diatoms and filamentous greens. Species succession continued beyond biomass equilibrium, with blue-greens important in deeper zones and greens developing best in upper, lighted regions. Radioisotope concentrations equilibrated rapidly in both artificial substrates and periphyton biomass. Zinc-65 was concentrated highly by the polyethylene tape, Cesium-137 moderately, and Cobalt-60 and Ruthenium-106 negligibly, if at all. Ambient concentrations of zinc-65 in water and periphyton were below detection. The other isotopes contributed about equally to biomass radioactivity. Biomass activity-densities of Ruthenium-106 and Cesium-137 increased slightly with depth; this pattern was pronounced for Cobalt-60. Factors considered to account for observed vertical distributions include: different radioisotope concentrations in surface and deep water; a hyperbolic rather than linear relationship between activity-density and biomass; and concentration of Cobalt-60 by blue-green algae as an essential element, or by microbiota for use in cobalamin synthesis. (Jones-Wisconsin)
W70-04371

PRIMARY PRODUCTIVITY IN THE GULF OF CALIFORNIA,
Scripps Institution of Oceanography, La Jolla, Calif; and California Univ., San Diego, La Jolla. Inst. of Marine Resources.
B. Zeitzschel.
Marine Biology, Vol 3, No 3, p 201-207, 1969. 3 fig, 2 tab, 33 ref.

Descriptors: *Primary productivity, *Water analysis, Photometry, Analysis, Light penetration, Phytoplankton, On-site tests, Laboratory tests, Ocean circulation.
Identifiers: *Carbon-14, *Research cruise, *Baja California, Submarine photometer, Upwelling, Tidal mixing, Gulf of California, Bay of Bengal, West African coast.

Primary productivity in the Gulf of California was investigated at 34 sampling stations during 6 cruises. Inoculation of water with carbon-14 at various depths and incubation for 1/2 a solar day revealed a considerably higher primary productivity than that of oceans at comparable latitudes. The Gulf exhibits four zones with mean values ranging from 0.272 grams carbon/square meter per day to 0.677 grams carbon/square meter per day. The average integrated rate of primary production from all stations is 0.382 grams carbon/square meter per day (0.002 to 0.932). This high productivity is comparable to that of the Bay of Bengal, the upwelling areas off the west coast of Baja California, or North Africa; it is two to three times greater than the productivity of open Atlantic or Pacific Oceans at similar latitudes. The recorded rate of primary productivity is in part due to seasonal upwelling down to shallow thermocline and to tidal mixing. (Wilde-Wisconsin)
W70-04374

LIFE ON A DYING LAKE,
Peter Schrag.
Saturday Review, p 19-21, 55-56, September 20, 1969. 3 photos.

Descriptors: *Lake Erie, *Great Lakes, *Eutrophication, *Water pollution, *Water pollution effects, Water pollution control, Water pollution sources, Water law, Recreation, Chlorination, Beaches.
Identifiers: *Lake Erie basin, Cuyahoga River (Ohio), Iron III, Ferric iron, Maumee River, Cleveland (Ohio).

A look at Lake Erie's pollution problems shows the conflicts between the social, economic, and political viewpoints. Erie has aged 15,000 years in the past 50 years, but the questions surrounding the cleanup concern resources, priorities, and the urgency, thus leaving the thirteen million people dependent on the lake in limbo. City sewers, industrial wastes, and runoff provide the input, while algae, low oxygen levels, smell, trash fish, river fire, and the necessity to chlorinate beaches are some results. There is fear that the Iron III compound keeping algae nutrients trapped on the lake bottom is being dissolved, which would result in sharply increased eutrophication if the nutrients are released. The cities have not corrected their sewage pollution before demanding that the states enforce anti-pollution standards, leaving federally conducted enforcement conferences to encourage the five lake-region states to commit themselves to remove 80% of the primarily detergent-oriented phosphates by waste treatment. Pollution law shows it's hard to demonstrate a connection between discharges and damages. 'Whose rights are affected', 'Whose environment is it', and 'Who controls the environment' are some of the basic questions approached. (Powers-Wisconsin)
W70-04375

SEASONAL TRENDS IN PHYSICOCHEMICAL FACTORS AND PLANKTON OF A FRESHWATER FISHPOND AND THEIR ROLE IN FISH CULTURE,
Madurai Univ. (India) Dept. of Zoology.
R. George Michael.
Hydrobiologia, Vol 33, No 1, p 144-160, 1969. 13 fig, 47 ref.

Descriptors: *Fish, *Ponds, *Physicochemical properties, Zooplankton, Phytoplankton, Crustaceans, Protozoa, Phosphates, Rotifers, Hydrogen ion concentration.
Identifiers: *India, Barrackpore (India), Fish culture.

A two-year study of seasonal variations in physicochemical properties was made on an 817.5 square meter freshwater pond. Water level varied from 1.9 to 2.6 meters depth, fluctuations due to alternate dry and monsoon seasons. Total alkalinity was inversely related to rainfall; phosphorus concentration was directly related to rainfall although modified by phytoplanktonic utilization. Range of temperature variation was about 19C; minima (14C) occurring in December, maxima (33C) occurring in June-July. Fluctuations in pH and dissolved oxygen did not conform to any seasonal trend. Carbon dioxide concentrations were directly correlated with amount and nature of biological activity. Protozoan populations were low except for peritrich ciliates in the second year of the study. Phytoplankton peaks (mainly flagellates) occurred in December to April; peaks of rotifer and planktonic crustacean populations occurred from February to April. Size of rotifer populations was correlated with high total alkalinity and temperature. Dissolved oxygen, carbon dioxide, and total alkalinity concentrations occur in ranges compatible with high fish yield. (Voigtlander-Wisconsin)
W70-04376

DISTRIBUTION OF CYANOPHAGES IN NATURAL HABITATS,
E. Padan, and M. Shilo.
Verhandlungen der Internationalen Vereinigung fur Theoretische und Angewandte Limnologie, Vol 17, p 747-751, November 1969. 2 tab, 7 ref.

Descriptors: *Viruses, *Ecological distribution, Biocontrol, Water pollution, Cyanophyta, Aquatic habitats, Eutrophication, Lakes, Photosynthesis, Dialysis.
Identifiers: *Cyanophages, Lyngbya, Plectonema, Phormidium, Microbial ecology, Israel, Beith Shean (Israel), Fish ponds, Lake Kinnereth (Israel), Species specificity, Plectonema boryanum, Seasonal effects, Biotopes, Schizothrix calcicola, Plaque-forming-units assay.

First described in 1963, a virus which lyses cyanophytes (blue-green algae), called 'cyanophage' because of its similarity to bacteriophages, is highly specific for algal genera: Lyngbya, Plectonema, Phormidium. It is commonly found in sewage waters. Since then, viruses attacking other cyanophytes have been isolated. Distribution of the organisms in Israeli water sources, and their variations with fluctuations in host populations were studied. Filtered samples (3 liters) were concentrated to 10 milliliters by dialysis, and the dialysate passed through ultrafine filter which passes virus particles. Clearing of a growing algal culture, when incubated with ultrafiltrate, indicates presence of cyanophages; these can be assayed quantitatively by counting plaques, each resulting from a single virus particle, which are formed when test mixture is incubated with agar culture of algae. Five samples from Lake Kinnereth, and over 90% of 40 samples from fish ponds contained phages specific for Plectonema. In 5 ponds, concentrations of cyanophages were in 1-13,000 particles/liter range, peak concentrations corresponding with development of cyanophyte blooms. Susceptible algae are not always isolatable from aquatic habitats where virus is found. Numbers of cyanophate-sensitive algae and concentrations of their viruses are apparently in a state of dynamic equilibrium. (Eichhorn-Wisconsin)
W70-04377

BACTERIAL UPTAKE OF ORGANIC SUBSTRATE: NEW METHODS OF STUDY AND APPLICATION TO EUTROPHICATION,
North Carolina State Univ., Raleigh. Dept. of Zoology.
John E. Hobbie, and Claude C. Crawford.
Verhandlungen der Internationalen Vereinigung fur Theoretische und Angewandte Limnologie, Vol 17, p 725-730, November 1969. 3 fig, 1 tab, 10 ref.

Descriptors: *Aquatic bacteria, *Organic matter, *Eutrophication, *Analytical techniques, Ecosystems, Aquatic habitats, Water pollution effects, Physiological ecology, Respiration, Carbon radioisotopes, Kinetics, North Carolina, Carbonates, Ponds, Regression analysis, Trophic level, Oligotrophy, Lakes, Estuaries, Sewage effluents, Rivers.
Identifiers: *Heterotrophy, Microbial ecology, Carbon-14, Michaelis-Menten equation, Turnover times, Uptake velocities, Millipore filtration, Glucose, Raleigh (NC), Aspartic acid, Hypereutrophy, South Creek (NC), Pamlico River (NC), Relative heterotrophic activity, Scintillation counting.

Methods for application of Michaelis-Menten kinetics to estimate parameters in bacterial assimilation of radiocarbon-labeled organic solutes from natural waters, described earlier, underestimate heterotrophic potential because they fail to consider loss of radioactivity in respired carbon dioxide. These errors are substantial and must be accounted for. Methods are described which accomplish incubation in presence of radioactive substrate in closed vessels. Respired carbon dioxide is absorbed on phenylethylamine-saturated chromatographic paper. After incubation, plankton are filtered onto membrane filter (0.5 micron pore size). Carbon-14 of both filter and absorbing paper is assessed by liquid scintillation counting. As test of methods, water from a small dairy farm pond was incubated with added radioactive glucose and aspartic acid. Corrected data, fitted by computer to Lineweaver-Burk plots, yielded straight lines, indicating that a transport system is operational in uptake. Fit for corrected data is better than for uncorrected. With glucose, mean of 28.9% radioactivity was respired (range for 8 samples: 28.3-32.4%); with aspartic acid, as much as 63.8% is respired. The Wright-Hobbie analysis was previously applied to lakes. Data are presented to demonstrate its application to rivers. Glucose uptake is stimulated at points of introduction into an estuarine river of sewage effluents and wastes from phosphate-mining. (Eichhorn-Wisconsin)
W70-04379

SOME PROBLEMS REMAINING IN ALGAE CULTURING,
Station d'Hydrobiologie Appliquee, Le Paraclet par Boves (France).
A. G. Wurtz.
Algae and Man, Jackson, Daniel F (editor), Plenum Press, New York, p 120-137, 1964.

Descriptors: *Analytical techniques, *Algae, *Growth rates, *Bioindicators, *Water pollution, *Waste treatment, Food chains, Chlorella, Chlorophyll, Physiological ecology, Cyanophyta, Eutrophication, Nuisance algae, Nitrogen, Phosphates, Hydrogen ion concentration, Cycling nutrients, Mud-water interfaces, Euglenophyta, Toxicity, Bioassays, Diatoms, Euglena, Sphaerotilus.
Identifiers: *Algal cultures, *Axenic cultures, Pediastrum, Self-purification, Algal enumeration, Scenedesmus, Growth equations, Ankistrodesmus, Heterotrophy, Continuous cultures, Chlamydomonas, Batch cultures, Optical density, Soil-water techniques, Phycology, Microcystis, Glocotrichia, Aphanizomenon, Micronutrients, Dinophyceae, Cryptophyceae, Chromatium, Oscillatoria, Antibiotic treatment, Chu's medium, Ultraviolet sterilization, Constructive synecology, Tabellaria.

Numerous problems exist among the interfaces between pure-culture study of algae and phycological ecology, especially as regards the quality of man's environment. While attainment of axenic cultures is, of itself, a valid goal, increasing use of such cultures, coupled with ecological insights, may yield useful information pertaining to many perplexing practical problems. Equations describing relationships among growth, yield, and biomass in batch and continuous cultures are reviewed, as are methods for evaluating algal growth. There remains a basic need for standardized techniques for assessing growth in algal cultures. Some aspects of techniques for axenic culturing are reviewed. Discrepancies between information on mineral nutrition of blue-green algae, as developed from studies of axenic cultures, and field observations of conditions leading to nuisance blooms need further study and clarification. The soil-water technique, which has been instrumental in successful culturing of some 500 strains of various algae, raises further ecological questions, including those of heterotrophy and conditions at the soil-water interface. Other similar questions considered in some detail in this report include influence of innoculum size on population growth; ecological implications of algal culture; self-purification of wastes by algae; algal indicators of water quality; and role of algae in food chains. (See Vol. 2, No. 19, Field 5C, W69-07832). (Eichhorn-Wisconsin)
W70-04381

EFFECTS OF ENRICHMENT IN MATHEMATICAL MODELS,
Michigan Univ., Ann Arbor.
Frederick E. Smith.
Eutrophication: Causes, Consequences, Correctives, Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. p 631-645. 5 fig.

Descriptors: *Eutrophication, *Mathematical models, *Systems analysis, Water pollution effects, Ecosystems, Simulation analysis, Analytical techniques, Computer models, Trophic level, Aquatic populations, Cycling nutrients, Food webs, Productivity, Predation, Herbivores, Aquatic plants, Organic matter, Growth, Numerical analysis, Detritus, Stochastic processes, Digital computers.
Identifiers: *Enrichment, IBM 7090, Michaelis-Menton equation, Feeding ability, Growth capacity, Inherent losses, Conversion efficiency, Decomposers, Nutrient limitation, Energy limitation, Rutte-Kunga methods, Rate processes.

Ecosystems are as complex as other highly intricate systems which have been adequately modeled, although levels of interest and resources in ecology may be inadequate to attain such modeling. Systems analysis does not require complete models, simplified versions often yielding meaningful insights into operation of dominant influences in actual systems. Simplified ecosystems of 3 or 4 trophic levels and a nutrient pool are describably by models which consider feeding ability, growth capacity, inherent losses, and conversion efficiency. Model for 3 populations has 12 parameters; that for 4, has 17. Models are analogous with Michaelis-Menton equation describing enzyme-saturation kinetics. Development of equations characterizing rate processes, into which stochastic processes were introduced, permitted systems simulation on computer (IBM 7090). Simulations suggest that effects of eutrophication may be systems effects which are independent of species composition, and that some accepted ecological concepts are challengeable. Behavior of models raises important ecological implications including--among others: Parameters in addition to those considered here control ecosystem stability, since population growth tends to cause oscillation to extinction; derivation of food-web stability from diversity is not supported; enrichment of system with mineral nutrients can cause flora to change to a less nutritious type. (See Vol. 3, No. 10, Field 5C, W70-03975). (Eichhorn-Wisconsin)
W70-04383

EVALUATING NUTRIENT SUPPLIES FOR THE GROWTH OF AQUATIC PLANTS IN NATURAL WATERS,
Wisconsin Univ., Madison. Dept. of Botany.
G. C. Gerloff.
Eutrophication: Causes, Consequences, Correctives, Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. p 537-555. 4 fig, 8 tab, 32 ref.

Descriptors: *Nutrient requirements, *Aquatic plants, *Water, Lakes, Streams, Carbon radioisotopes, Nitrogen, Phosphorus, Indicators, Soils, Bioassay, Surfaces, Iron, Nitrates, Phosphates, Chemical analysis, Wisconsin, Cultures, Trace elements, Hydrogen ion concentration, Cyanophyta
Identifiers: *Growth, Tissue analysis, Index tissues, Critical concentration, Field-plots, Microcystis aeruginosa, Lake Mendota (Wis), Physiological age, Vallisneria americana, Ceratophyllum demursum, Heteranthera dubia, Elodea occidentalis, Lake Monona (Wis), Najas flexilis, Zannichelia palustris, Lake Waubesa (Wis), Potamogeton.

No procedure for evaluating nutrient supplies and detecting growth-limiting factors in lakes and streams has been developed for general reliability and usefulness. The tissue-analysis procedure gives promise of being very useful in studies of aquatic environments. In an single analytical value, it provides for an integrated expression of availabilities of an element in various parts of a lake or stream from which an organism absorbed nutrients during growth. Many of sampling problems associated with the continual movement and shifting of the aquatic environment thus can be minimized. Enrichment cultures using carbon-14 to measure photosynthetic and biological activity appear somewhat more complex than tissue analysis. Among the problems in need of immediate study are: determining the most appropriate plant parts to sample and analyze; whether analysis for the total content of each element or for an extracted fraction more reliably correlates with yield; the critical concentrations for various species; whether certain species are particularly reliable indicators of water fertility--whether they would serve as indicator plants; the most reliable procedures for collecting plant samples in a particular body of water; the critical concentrations of essential elements, other than nitrogen and phosphorus, in several of the most important aquatic species. (See Vol. 3, No. 10, Field 5C, W70-03975). (Jones-Wisconsin)
W70-04384

GEOCHEMISTRY OF EUTROPHICATION,
General Dynamics Corp., Groton, Conn. Electric Boat Div.
Richard J. Benoit.
Eutrophication: Causes, Consequences, Correctives, Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. p 614-630. 3 fig, 6 tab, 30 ref.

Descriptors: *Geochemistry, *Eutrophication, *Water structure, Atmosphere, Sea water, Fresh water, Sorption, Sodium, Algae, Phosphorus, Trace elements, Plankton, Lakes, Rivers, Great Lakes.
Identifiers: *Equilibrium model, Lithosphere, Sorption reactions, Solubility equilibrium theory.

The tendency of the land-based hydrosphere to attain similar composition under the combined influences of the buffering action of ion-exchange reactions and integration of tributaries is stressed. The equilibrium model, based on solubility equilibria of common constituents of the lithosphere and carbon dioxide concentration equal to 35,000 atmospheres, gives a reasonably satisfactory agreement with the actual composition of water of the Great Lakes. While sorption reactions may cause some deviations from the equilibrium models, the major discrepancies in the chemical composition of waters are attributed to man's activity. This is particularly true of the contents of sodium and phosphorus, the two elements that may limit or unduly promote the algal growth. Trace

elements may also alter the trophic level of a lake to create a nuisance or even lead to a degradation of a resource. (See Vol. 3, No. 10, Field 5C, W70-03975). (Wilde-Wisconsin)
W70-04385

NUTRIENTS IN THE POTOMAC RIVER BASIN,
New York State Department of Health, Albany. Div. of Environmental Health Services.
Norbert A. Jaworski, Orterio Villa, Jr., and Leo J. Hetling.
FWPCA, Chesapeake Technical Support Laboratory, Technical Report No 9, May 1969. 40 p, 15 fig, 5 tab, 8 ref.

Descriptors: *Nutrients, *Eutrophication, *River basins, Agricultural wastes, Phosphates, Phosphorus compounds, Nitrogen compounds, Streamflow, Land use, Surface runoff, Mathematical models, Estuaries, District of Columbia, Chlorophyll, Regression analysis, Chlorella, Pennsylvania, Chlamydomonas, Maryland, Cyanophyta, West Virginia, Chlorophyta, Virginia, Biomass, Sampling, Nutrient cycling, Industrial wastes, Nitrites, Nitrates, Ammonia, Water pollution.
Identifiers: *Potomac River, Urban runoff, Seasonal effects, Washington (D C), Chlorophyll a, Predictive equations, Algal blooms, Anacystis, Water quality management, Sub-basins, Hydrographs, Isopleth diagrams, Nitrogen forms, Phosphorus forms, Nutrient loading.

The Potomac River system drains some 14,670 square miles of forested, agricultural, industrialized, and urbanized areas, in December 1968 receiving 382 known discharges. Basinwide studies were undertaken of water quality management, emphasizing eutrophication. In 1966, these studies yielded following estimates of average nutrient loading (in pounds/day) to surface waters of Potomac: phosphorus as phosphate (phosphate-P) --94,130; total nitrogen as nitrogen (N) --122,190. Of these loadings, 87% of phosphate-P and 53% of N originates as wastewater discharges. Inorganic N increases, P decreases with increased streamflow in non-tidal waters. Algal blooms, as indicated by concentrations of chlorophyll a, greater than 50 micrograms/liter were observed over 50 miles of upper Potomac estuary during June-October 1968. During months of decreased flow, high concentrations of total Kjeldahl N, nitrates and phosphates in upper estuary are principally attributable to wastewater discharge from District of Columbia metropolitan area. Studies of mass balance and transport, utilizing predictive equations, demonstrate that at steady state flows, 38% of P entering surface waters of upper basin are retained in channel, apparently in sediments and plants. Stability of such retention is not known. (Eichhorn-Wisconsin)
W70-04386

GALVESTON BAY: TEST CASE OF AN ESTUARY IN CRISIS,
Luther J. Carter.
In: Science, Vol 167, No 3921, p 1102-8, Feb 20, 1970. 1 fig.

Descriptors: *Estuarine environment, *Estuaries, *Landfills, *Diversion, *Water pollution, Marshes, Shellfish, Fishkill, Thermal pollution, Industrial wastes, Municipal wastes, Water demand, Water supply, Waste treatment, Inter-agency cooperation, Political aspects, Water zoning, Land use, Urbanization, Waste assimilative capacity.
Identifiers: *Galveston Bay, *Galveston, *Houston, *Houston Ship Channel, *Houston Lighting and Power Company, *Water Quality Board, *Gulf Coast Waste Disposal Authority, *Shelldredging, *U.S. Army Corps of Engineers, *Effluent standards, Texas Water Development Board, Texas Water Plan.

The Galveston Bay estuary's environmental crisis is reported. Long a major nursery area for shellfish and finfish, the bay's water quality has been severely degraded by rapid industrial and population growth. A 1914 decision to build the Houston Ship Channel has had far-reaching environmental effects. The industries and residential subdivisions which have grown up along the channel, dump raw sewage into it. This highly polluted water flows untreated into the Bay. Shelldredging, water diversions and landfill encroachments have severely reduced the nursery marshlands and increased salinity. The U.S. Corps of Engineers proposed Wallisville Dam will further aggrevate these situations, threatening estuarial life. The Houston Lighting and Power Company's new facility will add thermal pollution to the Bay's problems. Traditionally, the Texas state government has been insensitive to the water pollution problems of the state's few industrial-oriented municipalities. Thus, state water quality standards are low, but federally approved, and have never been enforced. The recent federal activity has prompted the hitherto dormant State Water Quality Board to take the offensive for the first time in its history, and the establishment of the Gulf Coast Waste Disposal Authority as a coordinating agency. (Richmond-Chicago)
W70-04432

PRIMARY PRODUCTION AND NUTRIENTS IN OGAC LAKE, A LANDLOCKED FIORD ON BAFFIN ISLAND,
Dalhousie Univ., Halifax (Nova Scotia). Dept. of Biology.
For primary bibliographic entry see Field 02H.
W70-04446

INFLUENCE OF MARINE PROTOZOA ON NUTRIENT REGENERATION,
Georgia Univ., Sapelo Island. Marine Inst.
R. E. Johannes.
Limnology and Oceanography, Vol 10, No 3, p 434-442, 1965. 4 fig, 2 tab, 34 ref.

Descriptors: *Marine animals, *Protozoa, *Nutrients, Phosphorus, Phosphate, Microorganisms, Crustaceans, Detritus, Bacteria, Phosphorus radioisotopes, Sewage, Georgia, Mud, Tidal waters, Sands, Beaches, Radioactivity, Tracers, Mussels, Grazing, Copepods, Diatoms, Benthos, Interfaces, Salt marshes, Continental shelf, Plankton, Nematodes, Hydrogen ion concentration.
Identifiers: *Regeneration, Macrofauna, Excretion, Ciliates, Flagellates, Uptake, Euplotes crassus, Euplotes vannus, Euplotes trisulcatus, Uronema, Spartina alterniflora, Sapelo Island (Ga), Dissolved phosphorus, Modiolus demissus.

High concentrations of ciliates and other protozoa are characteristic of decomposing sewage. Water bodies containing living organisms produce natural 'sewage' in form of dead organisms, feces, and dissolved metabolites. Per unit weight, marine protozoa excrete dissolved phosphorus one to two orders of magnitude faster than marine microcrustaceans and several orders of magnitude faster than marine macrofauna. Protozoa may be responsible for a major fraction of faunal nutrient excretion even though only present as a minor fraction of the faunal biomass. Regeneration of dissolved inorganic phosphate from organic detritus proceeds faster and more completely in the presence of bacteria and ciliates or colorless flagellates than in the presence of bacteria alone. An increased consumption of organic detritus in the presence of protozoa is performed by bacteria, which are kept in a prolonged state of 'physiological youth' by grazing protozoa. Present results indicate that it is the protozoa that produce, via excretion, the greater regeneration of nutrients from organic detritus. By constituting a nutrient source for protozoa, bacteria are indirectly involved in the increased regeneration. Bacterial activities greatly influence the pH of sediments and of bodies of water where circulation is restricted. (Jones-Wisconsin)
W70-04447

COMPOSITION AND NUTRITIVE VALUE OF FECAL PELLETS OF A MARINE CRUSTACEAN,
Georgia Univ., Sapelo Island. Marine Inst.
R. E. Johannes, and Masako Satomi.
Limnology and Oceanography, Vol 11, No 2, p 191-197, 1966. 2 fig, 2 tab, 27 ref.

Descriptors: *Chemical analysis, *Nutrients, *Marine animals, *Crustaceans, Ecosystem, Shrimp, Diatoms, Organic matter, Proteins, Bacteria, Light, Georgia, Microorganisms, Energy transfer, Herbivores, Carbon, Carbohydrates, Lipids, Phosphorus, Respiration, Ultraviolet radiation, Entropy, Detritus, Estuaries, Phytoplankton, Zooplankton.
Identifiers: *Fecal pellets, Palaemonetes pugio, Nitzschia closterium, Sapelo Island (Ga), Gastropods, Fundulus heteroclitus, Nassa obsoleta, Uca pugnax, Pagurus longicarpus, Autolysis, Solution, Euphotic zone.

The role of feces in energy flow and nutrient cycles in the marine ecosystem was examined using fecal pellets of the shrimp Palaemonetes pugio, fed on the diatom Nitzschia closterium. P pugio is extremely abundant in tidal creeks along the Georgia coast. The pellets were rich in organic matter, particularly protein and readily eaten by P pugio when diatoms were not available and assimilation efficiency was high, indicating that the pellets contained substantial absorbable organic matter. Solution and bacterial respiration reduced the organic content of feces while light and dissolved organic matter stimulated the growth of autotrophic and heterotrophic microorganisms. It is estimated that the incorporation rate of organic matter into fecal pellets exceeds the incorporation rate of organic matter into herbivore tissue and that fecal pellets constitute a major potential food source for marine animals. If fecal pellets were to sink quantitatively out of the euphotic zone, the result would be a rapid removal of large quantities of phosphorus from the upper waters. Results suggest two ways in which this loss is minimized: solution of fecal phosphorus and ingestion of fecal pellets and assimilation of phosphorus by zooplankton. (Jones-Wisconsin)
W70-04448

ANNUAL CYCLE, SPECIES DIVERSITY AND SUCCESSION OF PHYTOPLANKTON IN LOWER SARONICOS BAY, AEGEAN SEA,
Democritus Nuclear Research Center, Athens, Greece. Hydrobiology Group.
L. Ignatiades.
Marine Biology, Vol 3, No 3, p 196-200, 1969. 1 fig, 3 tab, 6 ref.

Descriptors: *Cycles, *Succession, *Phytoplankton, Sampling, Diatoms, Light intensity, Phosphates, Grazing, Dinoflagellates, Seasonal, Nutrients, Population, Nitrates, Silicates, Turbulence, Primary productivity, Columns, Stratification.
Identifiers: *Saronicos Bay (Aegean Sea), Diversity index, Asterionella, Asterolampra, Asteromphalus, Bacteriastrum, Biddulphia, Chaetoceros, Cerataulina, Coscinodiscus, Dactyliosolen, Ditylum, Eucampia, Hemiaulus, Leptocylindrus, Licmophora, Nitzschia, Rhabdonema, Rhizosolenia, Skeletonema, Streptotheca, Thalassionema, Ceratium, Thalassiosira, Thalassiothrix, Amphisolenia, Dinophysis, Exuviella, Peridinium.

Annual cycles of diatoms and dinoflagellates in the lower Saronicos Bay, Aegean Sea, are described on the basis of net samples collected during 1967. The annual cycle is largely due to changes in diatom concentrations (cells/liter), while the dinoflagellate concentrations remain constant. A pronounced spring diatom bloom is followed by a quantitative and qualitative decline of diatoms in summer due mainly to high light intensities, phosphorus depletion and extensive grazing. Autumnal diatom increase lasts during the rest of the year; the phase of small diatoms develops incompletely. The theoretical model of species succession is affected by poor

nutritional conditions of the bay. Low species diversity levels prevail during the spring phytoplankton bloom; diversity increases in later succession stages. Results do not suggest any clear limiting effect of nitrate and silicate concentrations on phytoplankton abundance. Dinoflagellates formed a constant component of the plankton at all seasons, but were characterized by their sparsity. The two observed maxima did not total more than 400 cells/liter; in summer and early autumn their occurrence was 20-100 cells/liter. The population was dominated by the Ceratium community throughout the year. (Jones-Wisconsin)
W70-04450

EFFECTS OF CONTROLLED NUTRIENT DILUTION OF A EUTROPHIC LAKE,
Seattle, Wash.
Ray T. Oglesby.
Water Research, Vol 2, p 106-108, 1968. 2 fig, 5 ref.

Descriptors: *Eutrophication, *Lakes, *Nutrients, Recreation, Washington, Cyanophyta, Chlorophyll, Phosphates, Nitrates, Phytoplankton, Primary productivity, Water quality, Standing crop, Alkalinity, Sodium, Molybdenum, Nitrogen fixation.
Identifiers: Green Lake (Wash), Flushing, Transparency, Dilution, Aphanizomenon holsaticum, Flos-aquae, Anacystis, Gleotrichia echninulata, Anabaena circinalis, Dilution water, Seattle (Wash).

Green Lake, located near the center of Seattle, Washington, has an intensive recreational use and represents a valuable resource. To prolong the life of this body of water to improve its quality, large quantities of nutrient-poor water were diverted from the city's potable supply through the lake. In determining the effectiveness of this program, Green Lake has been sampled at least once each month during the winter and two to four times per month during the rest of the year, during a three year period. Chief emphasis has been placed on variations in nutrient levels, transparency, presence of phytoplankton species and primary production levels as related to the addition of large volumes of dilution water. Although the pattern is complex, the trend toward improved conditions is definite. Two postulates are advanced for the decreased eutrophication resulting from the flushing: decrease in availability of primary nutrients, and a decrease in the overall mineral content to a very low level resulting in algal species changes and primary production limitations due to trace element deficiences. Concentrations of nitrate indicate an apparent correlation with the very high productivity peaks exhibited in 1959. (Jones-Wisconsin)
W70-04451

PRELIMINARY STUDIES ON PRIMARY PRODUCTIVITY AT PAYAKONDA, GULF OF KANDALAKSHA, WHITE SEA,
Akademiya Nauk SSSR. Institut Okeanologii.
K. Radhakrishna.
Marine Biology, Vol 3, No 2, p 188-190, 1969. 1 fig, 2 tab, 14 ref.

Descriptors: *Tidal effects, *Tides, *Primary productivity, Phytoplankton, Photosynthesis, Nitrate, Oxygen, Analysis, Light intensity, Insulation, Phosphate.
Identifiers: *High tides, *Low tides, White Sea, Kandalaksha Gulf, Payakonda (White Sea), High Venice Lagoon (Italy), Beaufort Channel.

The primary production in the near-shore, shallow part of the Gulf of Kandalaksha was investigated during late summer by the light and dark bottle method and the use of carbon-14. Sampling of water was confined to the surface and 3-meter depth. Oxygen samples were exposed to light for 24 hours; carbon-14 samples, for 6 hours. Surface insulation was determined with a pyrheliometer and subsurface insulation by a submarine photometer. Radioactivity was measured by an end-window Geiger counter. The oxygen determinations of photosynthesis were about three times as high as those obtained with carbon-14 values. In spite of restricted light penetration to the 3 meter depth, the rate of production in milligrams carbon/cubic meter per day was high. Low tide waters had a higher concentration of nutrients and growth stimulating effect than high tide waters. (Wilde-Wisconsin)
W70-04454

THE FUTURE OF THE LAKE,
Washington Univ., Seattle. Dept. of Zoology.
W. T. Edmondson.
Municipality of Metropolitan Seattle, Metro Quarterly, Fall 1965. 4 p, 1 fig.

Descriptors: *Algae, *Water pollution treatment, Lakes, Sewage, Drainage districts, Debt, Costs, Cities.
Identifiers: *Lake Washington (Wash), Seattle (Wash), Revenue bonds, Metro Act (Seattle).

Originally Seattle, Washington, released non-treated sewage into Puget Sound and treated sewage into Lake Washington. Swimming in the sound was destroyed, and Lake Washington became eutrophic. The Metro Act enacted in 1957 provided for the establishment of a metropolitan municipal corporation with the power to perform sewage disposal, water, parks, transportation, comprehensive planning and/or garbage disposal. In 1958 the sewage disposal proviso was approved by 60% vote. July 1966 should see the end of sewage discharge into Lake Washington. $120 million in revenue bonds have been sold to date, to be repaid by a $2 monthly charge per residential connection and a $2 monthly charge per 900 cubic feet of water used by industrial and commercial enterprises. Prompt improvement in the lake is expected within a few years after final diversion in 1966 as the watershed is relatively poor in dissolved minerals including nutrients needed by algae, and as there are no massive deposits of accumulated soft sediments on the lake bottom rich in nutrients available to algae, the prognosis is good for the recovery of Lake Washington. (Powers-Wisconsin)
W70-04455

EUTROPHIC EFFECTS AT THE MOUTH OF A GREAT RIVER (GRAND RHONE) (IN FRENCH),
Centre d'Oceanographie, Marseille (France). Station Marine d'Endoume.
F. Blank, M. Leveau, and K. H. Szekielda.
Marine Biology, Vol 3, No 3, p 233-242, 1969. 19 fig, 4 tab, 13 ref.

Descriptors: *Eutrophication, *Rivers, Salinity, Temperature, Nutrients, Gulfs, Phytoplankton, Zooplankton, Chlorophyll, Seston, Organic matter, Brackish water, Fresh water, Sampling, Phosphates, Nitrates, Biomass, Fish, Winds, Precipitation (Atmospheric), Currents (Water), Marine plants, Benthic flora, Dinoflagellates, Diatoms, Copepods, Mollusks, Crustaceans, Chordates.
Identifiers: *Mouth, *Rhone (France), Mediterranean Sea, Marseilles (France), Port Saint-Louis (France), Coriolis (France), Provence (France), Chaetoceros curvisetus, Nitzschia closterium, Radiolaria, Tintinnida, Cladocerans, Paracalanus parvus, Acartia clausi, Centropages typicus, Evadne spinifera, Podon polyphemoides, Coelenterata, Chaetognathes, Decapod larvae, Penilia avirostris, Conchoecia spinirostris, Creseis acicula.

A study of hydrographical and biological parameters in surface waters near the mouth of the Rhone River was made. Salinity, temperature and nutrient salts have been recorded, and phytoplankton, together with zooplankton, quantitatively and qualitatively analyzed. Chlorophyll a, seston, and organic matter concentration had been determined. The hydrographical structure near the Rhone is heterogenous and biological results are difficult to explain on the basis of hydrographical parameters. The numerical data of zooplantkton in the area are 10 times higher than in the Mediterranean Sea. Major composition of zooplankton is copepods and cladocerans, with Paracalanus parvus and Acartia clausi the dominant species. There is a great abundance of brackish and fresh water phytoplankton in the dilution zone, but these cells are dead or almost dead, coinciding with the low concentrations of chlorophyll a. The temperature and salinity show the hydrologic complexity. The Rhone's fresh water runs into neritic water, influencing a strong dilution zone on both sides of the main current, gradient being stronger at the east than west. Line of demarcation between the zones is a veritable frontier where the salinities quickly change from 10 to 37 parts/thousand. (Jones-Wisconsin)
W70-04460

MYCOLOGICAL INVESTIGATIONS OF THE BLACK SEA,
Miami Univ., Fla. Inst. of Marine Science; and Miami Univ., Fla. Dept. of Microbiology.
Samuel P. Meyers, Donald G. Ahearn, and Frank J. Roth, Jr.
Bulletin of Marine Science, Vol 17, No 3, p 576-596, 1967. 5 fig, 3 tab, 21 ref.

Descriptors: *Investigations, Yeasts, Molds, Density, Depth, Fungi, Sampling, Hydrography, Atlantic Ocean, Indian Ocean, Thermocline, Hydrogen sulfide, Distance, Sedimentation.
Identifiers: *Mycological, *Black Sea, Debaryomyces hansenii, Candida diddensii, Rhodotorula, Rhodotorula glutinis, Hyphomycetes, Cladosporium herbarum, Cladosporium cladosporioides, Aureobasidium pullulans, Physiological characteristics, Morphology, Current boundaries, Hansenula jadinii, Cryptococcus, Torulopsis, Sporobolomyces, Taphrina, Alternaria, Aspergillus, Nigrospora sphaerica, Fusarium oxysporum, Cephalosporium, Papularia sphaerosperma.

The Black Sea basin, generally devoid of vertical equalizing currents, is characterized by a decrease in oxygen with increasing depths. Its peculiar hydrochemical nature makes it an excellent locale for evaluation of distribution parameters and activity of specific fungal taxa. A collection of 558 molds and yeasts from the Black Sea has been characterized and population densities established. Of 174 water samples taken, 84 were positive for yeasts, while 97 contained molds. Average yeast density was less than 10 cells/liter while densities in excess of 20 cells/liter were found in only six samples. The maximal yeast population was 150 cells/liter. Decrease in incidence, density, and average number of yeast species was noted with increasing depth. Predominant taxa included the yeasts, Debaryomyces hansenii, Candida diddensii, Rhodotorula rubra, and Rhodotorula glutinis, and the hyphomycetes, Cladosporium and Aureobasidium pullulans. Generally, low concentrations of fungi prevented definitive correlation of individual species distribution with hydrographic aspects. Comparison of data with those obtained in earlier yeast studies in the Black Sea suggests that the previous information, and generalizations derived therefrom, must be critically re-evaluated. (Jones-Wisconsin)
W70-04461

CHANGES IN METAL COMPOSITION OF THE QUAHAUG CLAM, MERCENARIA MERCENARIA, AFTER EXPOSURE TO INSECTICIDES,
Bureau of Sport Fisheries and Wildlife, Highlands, N.J. Fish-Pesticide Research Lab.
Ronald Eisler, and Melvin P. Weinstein.
Chesapeake Science, Vol 8, No 4, p 253-258, 1967. 2 fig, 2 tab, 18 ref.

Descriptors: *Metals, *Insecticides, *Water pollution effects, Organophosphorus pesticides, Chemical analysis, Sodium, Potassium, Magnesium, Iron, Calcium, Zinc, Bioindicators, Environmental effects, Clams, Estuaries, Physiological ecology, New

Jersey, Bioassays, Toxicity, Fish, Crustacea, Trace elements.
Identifiers: *Chemical composition, *Quahaug clam, *Mercenaria mercenaria, Methoxychlor, Malathion, Organochloride pesticides, Raritan Bay (NJ), Anguilla, Fundulus, Mugil, Sphaeroides, Menidia, Palaemonetes, Crangon, Pagurus.

Estuarine faunas are particularly susceptible to deleterious effects of chemical pesticides because such compounds, disseminated from drainage systems, tend to accumulate in estuaries. A variety of pesticide-induced disturbances of physiology and behavior have been demonstrated for various marine organisms. Adult quahaug clams were subjected to graded concentrations of insecticides, Malathion (organophosphorus) and methoxychlor (organochloride), for 96 hours under standardized conditions (24/mill salinity; 20C; aeration; daily light cycle: 10 hours at 25 foot-candles, 14 hours darkness). Clams appeared normal at highest concentrations (parts/billion) tested: Malathion--37,000; methoxychlor--1,100. Quahaugs are more resistant to these insecticides than are many marine fishes and crustaceans, for which toxicity data are presented. Exposed clams, removed to uncontaminated medium, survived at least 133 days post-exposure, apparently unaffected by treatment. Metallic composition of whole animals and selected tissues (gill, mantle, muscle) were analyzed by atomic absorption spectrophotometry. Profiles, presented as shifts in composition, between control and experimental animals, as function of pesticide dose, indicate changes in sodium, potassium, magnesium, iron, and marked changes in calcium and zinc. Such profiles may provide means of identifying unfavorable environmental effects before more drastic changes occur. Disproportionate changes in metallic composition of clams need further study. (Eichhorn-Wisconsin)
W70-04462

OUTWITTING THE PATIENT ASSASSIN: THE HUMAN USE OF LAKE POLLUTION,
Northwestern Univ., Evanston, Ill. Technological Inst.
Harold B. Gotaas.
Bulletin of the Atomic Scientists, p 8-10, May 1969.

Descriptors: *Nutrients, *Benefit-cost analysis, *Lake Erie, Phosphorus, Fish stocking, Commercial fish, Salmon, Algae, Fish.
Identifiers: Antipollution programs, Biological balance, Overfishing, Coho salmon, Alewife, Nutrient removal.

Some aspects of the October 1968 Department of Interior report on Lake Erie are challenged. The emphasis on nutrient removal which would result in immediate expenditure of $1.1 billion to control municipal pollution and $285 million for curbing industrial contamination is questioned in light of the expected benefits. Several efficacious alternatives for reviving the Great Lakes are suggested: (1) further nutrient relationships and cost versus benefits studies should be undertaken before money is spent to build expensive treatment facilities; (2) harvest algae as a potential source of food thus preventing it from contributing to the organic waste load; (3) prevent the introduction of all toxic materials enabling desirable biological balances to be established; (4) seed the lakes with desirable fish to establish a food chain which would permit the growth and removal of nutrients as well as fish for food needs and sport; and (5) adopt water quality standards that are realistic as to their costs, benefits, and time priorities. (Haskins-Wisconsin)
W70-04465

THE ROLE OF CULTURED POND FISH IN THE CONTROL OF EUTROPHICATION IN LAKES AND DAMS,
Fish Culture Research Training Inst., Malacca (Malaysia).
G. A. Prowse.
Verhandlungen der Internationalen Vereinigung fur Theoretische und Angewandte Limnologie, Vol 17, p 714-718, 1969. 15 ref.

Descriptors: *Eutrophication, *Fish farming, *Lakes, *Impoundments, *Water pollution control, Cyanophyta, Fish, Aquatic plants, Herbivores, Environmental effects, Fertilization, Phosphates, Diatoms, Chlorophyta, Nitrogen, Tropical regions.
Identifiers: Helostoma temmincki, Mugil, Hypophthalmichthys molitrix, Tilapia mossambica, Macrophytes, Tilapia zillii, Tilapia melanopleura, Ctenopharyngodon idellus, Grass carp, Lemna, Spirodela, Eichhornia, Pistia, Salvinia, Sedges, Melacca (Malaysia), Malaya, Anabaena inaequalis, Anabaenopsis raciborskii, Anabaena flos-aquae, Anabaena spiroides, Microcystis acruginosa, Silver carp, Calothrix, Aphanizomenon flos-aquae, Oscillatoria, Oedogonium, Planktophage fishes, Ceratium.

Less desirable enrichment effects of the hydrosphere with plant nutrients include excessive growths of various aquatic macrophytes, and of algae, usually blue-greens. In certain situations, introduction of cultured pond fishes offers a means of controlling those manifestations of eutrophication. Criteria for suitable candidates include: (1) fish should be planktophagous or herbivorous; (2) they should not create a nuisance by spreading; (3) they must co-exist peacefully with other species without detriment to latter; (4) they must maintain their numbers in face of predation; and (5) they must tolerate existing temperature conditions. Among suitable choices of macrophyte-feeders are Tilapia zillii, T melanopleura, and the grass carp, Ctenopharyngodon idellus. Tilapia will not tolerate temperatures below 10C, but are very fecund under tropical conditions. Ctenopharyngodon has wide temperature tolerance, but its spawning must be induced artificially with pituitary injections. Suitable planktophages include Tilapia mossambica and related species, and silver carp, Hypophthalmichthys molitrix. These Tilapia do not thrive below 13C, but spawning of silver carp is easier than with Ctenopharyngodon. Combinations of planktophages and herbivores are often desirable. In eutrophic brackish lakes, like Lake Onondaga, New York, various mullets (Mugil) might be suitable planktophages. (Eichhorn-Wisconsin)
W70-04467

ALGAE FROM WESTERN LAKE ERIE,
Ohio State Univ., Columbus. Dept. of Botany and Plant Pathology.
Clarence E. Taft, and W. Jack Kishler.
Ohio Journal of Science, Vol 68, No 2, p 80-83, 1968. 9 fig, 7 ref.

Descriptors: *Algae, *Lake Erie, Chlorophyta, Cyanophyta, United States, Habitats.
Identifiers: *New species, *Western Lake Erie (Ohio), Gongrosira stagnalis, Nephrocytium obesum W and G S West, Radiococcus nimbatus, Uronema elongatum Hodgetts, Chroococcus prescottii, Calothrix fusca, Microcoleus lacustris (Rab) Farlow, Cladophora, Taxonomic descriptions, Gongrosira lacustris Brand, Gongrosira debaryana Rab, Oocystis, Oscillatoria, Ulothrix, Eucapsis alpina Clements and Schantz, Scytonema alatum (Carm) Borzi, Scytonema myochrous.

Four species of algae in the Chlorophyta (Gongrosira stagnalis, Nephrocytium obesum, Radiococcus nimbatus, and Uronema elongatum) and five in the Cyanophyta (Chroococcus prescotti, Calothrix fusca, Microcoleus lacustris, Scytonema alatum, and Scytonema myochrous) are newly reported for western Lake Erie. Gongrosira stagnalis (G S West) Schmidle, collected from the basal fragments of old Cladophora, appears to be a new record for the United States. Nephrocytium obesum W and G S West, which is reported as often having a shallowly scrobiculate wall, is unique and merits further intensive study. These new algae occasionally appear in teaching and research collections at Stone Laboratory, Put-in-Bay, Ohio. The habitat of G stagnalis on calcium-encrusted Cladophora filaments is unique. (Jones-Wisconsin)
W70-04468

HEMATOLOGICAL ASPECTS OF THE THERMOACCLIMATORY PROCESS IN THE RAINBOW TROUT, SALMO GAIRDNERI,
Marquette Univ., Milwaukee, Wis. Dept. of Biology.
Mary Anne DeWilde, and A. H. Houston.
Journal, Fisheries Research Board, Canada, Vol. 24, No. 11, p. 2267-2281, Nov. 1967. 2 fig., 2 tab., 31 ref.

Descriptors: *Temperature, *Oxygen demand, *Acclimatization, *Rainbow trout, Fish.
Identifiers: Erythrocyte abundance, Hemoglobin concentrations, Mean erythrocytic volume and hemoglobin content.

The blood oxygen capacity of the rainbow trout has been investigated as a function of thermal acclimation in terms of erythrocyte abundance, packed cell volume, hemoglobin concentrations, and mean erythrocytic volume and hemoglobin content. Fish at the lower acclimation temperatures employed (3 deg, 7 deg C) were characterized by relatively low erythrocyte counts, hematocrits, and hemoglobin levels. Mean erythrocyte volumes tended to be relatively high, whereas mean erythrocytic hemoglobin content was somewhat below that typical of the higher temperature groups. In general, animals held at intermediate temperatures (11 deg, 14 deg, 17 deg C) showed significant increases in oxygen-carrying capacity by comparison with cold-acclimated fish. Finally, trout at 21 deg C typically had larger numbers of somewhat smaller red cells, more hemoglobin, and higher levels of hemoglobin per erythrocyte than either the lowor intermediate-temperature fish. Significant differences were observed between summer and fall-winter series of trout, particularly with respect to hemoglobin levels. The results do not indicate that modification in blood oxygen capacity are of major importance in the solution of the temperature-oxygen demand problem. However, there is support for the suggestion that hematological responses which do occur take place in approximately stepwise fashion. (Speakman-Vanderbilt)
W70-04470

THE EFFECT OF IMPOUNDMENTS ON NATURAL WATERS (IN GERMAN),
Akademiya Nauk SSSR, Leningrad (USSR).
For primary bibliographic entry see Field 02H.
W70-04475

TEMPERATURE CONTROL OF RESERVOIR RELEASES INTO NOLIN AND BARREN TAILWATERS,
Department of Fish and Wildlife Resources, Ky.
For primary bibliographic entry see Field 02H.
W70-04478

TREATMENT OF ALGAE AND WEEDS IN LAKES AT MADISON,
Health Dept., Madison, Wis. Lab.
For primary bibliographic entry see Field 02H.
W70-04494

THE BOTTOM FAUNA OF LAKE VATTERN, CENTRAL SWEDEN, AND SOME EFFECTS OF EUTROPHICATION,
For primary bibliographic entry see Field 02H.
W70-04495

THE ECOLOGICAL DECLINE OF LAKE ERIE,
New York State Coll. of Agriculture, Ithaca.
For primary bibliographic entry see Field 02H.
W70-04496

INFLUENCE OF POLLUTION ON THE BOTTOM FAUNA OF THE SOUND (ORESUND),
Lund Univ. (Sweden). Dept. of Animal Ecology.
Rolf Henriksson.
Oikos, Vol 20, No 2, p 507-523, 1969. 22 fig, 1 tab, 23 ref.

Descriptors: *Water pollution, *Sound, Sediments, Water chemistry, Oxygen, Indicators, Hydrogen sulfide, Bacteria, Hydrogen ion concentration, Temperature, Salinity, Sewage effluents, Ice, Seasonal, Ammonia, Nitrites, Nitrates, Phosphorus, Invertebrates, Chemical analysis, Domestic wastes, Industrial wastes, Drainage water, Rain, Anaerobic conditions, Eggs, Habitats, Foods, Population, Clostridium.
Identifiers: *Bottom fauna, *Oresund (Sweden), Copenhagen (Denmark), Nereis diversicolor, Scoloplos armiger, Capitella capitata, Ampharete grubei, Terebellides stromi, Macoma balthica, Cardium lamarcki, Mya arenaria, Halicryptus spinulosus, Clostridium perfringers, Escherichia coli, Spio fuliginosa, Tubifex, Azoic area.

Pollution distribution estimates in the Sound (Oresund) between southern Sweden and Sjaelland, have been made based on frequency of indicator organisms. The relationship between sediment, water chemistry, and bottom fauna were investigated as well as the resistance of indicator species to low oxygen contents and hydrogen sulphide and their correlation to bacterial pollution. A narrow azoic zone close to the Sjolunda outlet and a similar zone on the Danish side outside Provesteen are heavily polluted as are the inner part of the Lomma Bay and a large area outside Copenhagen. Almost all the rest of the research area on the Danish side and the outer parts of the Lomma Bay are influenced by pollution with the exception of a small peripheral part of the study area outside Copenhagen. No pollutional influences were noted in small areas on the Swedish side and south of the Isle of Ven. A bottom community of Nereis diversicolor Muller, Scoloplos armiger Muller, Capitella capitata (F), Ampharete grubei Malmgren, Terebellides stromi Sars, Macoma balthica (L), Cardium lamarcki Reeve, Mya arenaria L, and Halicryptus spinulosus v Siebold proved useful in indicating pollution. (Jones-Wisconsin)
W70-04499

FISH AS INDICES OF EUTROPHICATION,
British Columbia Univ., Vancouver.
P. A. Larkin, and T. G. Northcote.
Eutrophication: Causes, Consequences, Correctives, Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969. p 256-273. 1 fig, 88 ref.

Descriptors: *Fish, *Eutrophication, Nutrients, Population, Growth rates, Foods, Pollutants, Distribution, Mortality, Reproduction, Ponds, Spatial distribution.
Identifiers: Fish food habits, Eutrophication indices, Fish culture, Ecological effects, Fish populations, Benefits of eutrophication.

Deliberate eutrophication has long existed as a practice in fish culture. Fish are the last, and perhaps least, affected by eutrophication; their variability in spatial distribution, growth, food habits, and survival make assessment of eutrophication effects difficult. This is offset somewhat by available statistics on population dynamics, by availability of physiological data, and by public interest. Nutrient-rich pollutants and their high oxygen demand affect fish directly, often lethally, at all life stages. High concentrations of decay-produced carbon dioxide adversely influence respiration; sedimentation and fungal growths adversely affect food organisms and spawning substrates. Sublethal effects may be more serious factors in population survival; these include sensory impairment, tissue degeneration, organ malfunction, changes in endocrine balance, and alterations in competitive success. Early stages of eutrophication may enhance growth, later stages may force changes in food habits and spatial distribution. Eutrophication has induced changes in yield and species composition of fish populations. The degree of advantage gained from eutrophication depends on better knowledge of processes involved in eutrophication and diversion of now-wasted nutrients into controlled culture processes. (See Vol. 3, No. 10, Field 5C, W70-03975). (Voigtlander-Wisconsin)
W70-04501

SOME ASPECTS OF FEEDING IN ZOOPLANKTON,
Michigan Univ., Ann Arbor.
George W. Saunders, Jr.
Eutrophication: Causes, Consequences, Correctives, Printing and Publishing Office, National Academy of Sciences, Washington D C, 1969, p 556-573. 2 fig, 5 tab, 33 ref.

Descriptors: *Feeding rates, *Zooplankton, Physiological ecology, Nutrition, Aquatic bacteria, Detritus, Organic matter, Kinetics, Radioisotopes, Daphnia, Food webs, Copepods, Environmental effects, Carbon radioisotopes, Michigan, Temperature, Phytoplankton, Biomass, Water pollution effects, Eutrophication.
Identifiers: *Trophic ecology, Cyclops bicuspidatus, Filtering rates, Frains Lake (Mich), Carbon-14, Ceriodaphnia, Bosmina, Nauplius, Tropocyclops, Keratella, Conochiloides, Codonella, Douglas Lake (Mich), Lancaster Lake (Mich), Nigger Creek (Mich), Assimilation.

A general system of zooplankton feeding is presented. The food system may be viewed as a buffered system. In lakes with little organic detritus, zooplankton depend primarily on phytoplankton. Detritus and bacteria provide an important food supply only during terminal phases of major phytoplankton blooms--providing a lightly-buffered system. Where organic detritus is at high concentrations, detritus may occupy a dominant role, together with phytoplankton, in zooplankton feeding. This system is highly buffered as sharp changes in concentrations of one food source are compensated. Bacteria generally have their major role in mineralization processes rather than as a food source, although certain conditions (decay of algal blooms) transpose them to an important food. Information on zooplankton feeding is confusing; discrepancies may be due to studying portions of systems or analyzing different systems. It is possible to determine filtering rates and analyze zooplankton feeding systems in nature; which may be easier than synthesizing such systems in the laboratory. Tabular data include estimates of total carbon assimilation by zooplankton under natural conditions. (See Vol. 3, No. 10, Field 5C, W70-03975). (Voigtlander-Wisconsin)
W70-04502

ALGAL NUTRITION AND EUTROPHICATION,
Haskins Labs., New York.
Luigi Provasoli.
Eutrophication: Causes, Consequences, Correctives, Printing and Publishing Office, National Academy of Sciences, Washington, D C, 1969, p 574-593. 2 fig, 3 tab, 72 ref.

Descriptors: *Eutrophication, *Algae, *Nutrients, Nitrogen, Phosphorus, Sodium, Potassium, Trace metals, Vitamins, Water pollution, Physiological ecology, Diatoms, Oligotrophy, Cyanophyta, Chlorophyta, Great Lakes, Bioindicators, Fish, Washington, Lakes, Indiana, Ochromonas, Phytoplankton, Seaweeds.
Identifiers: *Algal nutrition, Ditylum, Chaetoceros, Skeletonema, Thalassiosira, Coccolithus, Sargasso Sea, Synura, Gymnodinium, Chemical symbiosis, Microbial ecology, Dinobryon, Volvox, Pandorina, Spirogyra, Synechococcus, Chroococcus, Oscillatoria, Nostoc, Anabaena, Anacystis, Microcystis, Bosmina, Asterionella, Melosira, Synedra, Fragilaria, Ceratium, Sweden, Aphanizomenon, Rhodomonas, Cryptomonads, Chrysomonads, Euglenids, Dinoflagellates.

Prevalent emphasis on nitrogen and phosphorus notwithstanding, little doubt exists that other nutrients play roles in eutrophication of natural waters. Also, accent is on aspects of biological overproduction in eutrophication, whereas more visible manifestations are changes in community structure, producing less desirable species via alterations in food chains. From these viewpoints, unfortunately little is known regarding ecologically important species. Selected nutritional aspects of algae are reviewed as regards nitrogen, phosphorus, sodium, potassium, trace metals, vitamins, and chemical symbiosis. In some situations, growth of chlorophytes (green algae) are favored by high concentrations of nitrogen, phosphorus, and potassium. Where chlorophytes are replaced, nitrogen-fixing blue-green algae may take over because nitrogen is too scarce to meet requirements of chlorophytes. It is known that both sodium and potassium increase during eutrophication. Such changes may be functional as well as indicative of eutrophication. Although trace elements are of acknowledged significance in algal nutrition, few reliable ecological data are available, and additional research is required. Vitamins are likely to be rich in eutrophic environments, a matter of importance since 197 of 204 algal species studied require vitamins, and since a pattern of vitamin requirements is beginning to emerge for various taxonomic groups. (See Vol. 3, No. 10, Field 5C, W70-03975). (Eichhorn-Wisconsin)
W70-04503

AGRICULTURAL DRAINAGE AND EUTROPHICATION,
Wisconsin Univ., Madison.
J. W. Biggar, and R. B. Corey.
Eutrophication: Causes, Consequences, Correctives, Printing and Publishing Office, National Academy of Sciences, Washington, d c, 1969. p 404-445, 8 fig, 14 tab, 69 ref.

Descriptors: *Agricultural watershed, *Subsurface drainage, *Drainage, *Eutrophication, Nitrogen, Phosphorus, Surface waters, Percolation, Suspended load, Groundwater, Aquifer characteristics.
Identifiers: *Agricultural drainage, Dissolved nutrients, Water mixing, Russian River (Calif), Yakima Basin (Pacific Northwest), Lake Mendota (Wis).

A comprehensive review of numerous aspects involved in the relationship of agricultural drainage and water eutrophication is presented. Particular attention is given to chemical reactions that nitrogen and phosphorus undergo in soil-water system. The fate of nutrients transported by surface runoff, interflow, and deep percolating water is determined by complex coinfluencing factors, such as nature of suspended material, heterogeny of soil profile, and degree of water mixing. Stress is placed on the inapplicability of macro-parameters, such as average hydraulic conductivity, to processes occurring on a microscopic scale. The report includes illustrations of plant nutrient loss from harvested areas and contributions of fertilizing elements from agricultural lands. An appraisal of agricultural drainage influence on eutrophication requires investigations of chemical and mineralogical contents of runoff waters in different seasons, dynamics of groundwater, and water in the unsaturated zone below root systems. (See Vol. 3, No. 10, Field 5C, W70-03975). (Wilde-Wisconsin)
W70-04504

NUTRIENT OUTPUT FROM MANAGED FORESTS,
Michigan Univ., Ann Arbor.
Charles F. Cooper.
Eutrophication: Causes, Consequences, Correctives, Printing and Publishing Office, National Academy of Sciences, Washington, DC, p 446-463, 1969. 3 tab, 39 ref.

Descriptors: *Riparian land, *Forests, *Forest fires, *Forest soils, Eutrophication, Ecosystems,

Nutrients, Runoff, Seepage, Subsurface flow, Stream gages, Lysimeters, Environmental sanitation, Fertilization, Statistical models, Estimating, Stochastic processes, Clear-cutting.
Identifiers: Forest hydrochemistry, Watershed input-output, Forest fertilization, Thin-film water dynamics.

Under undisturbed conditions, well stocked forest stands make very small contribution to eutrophication of natural waters, retaining nearly all input of phosphorus and nitrogen. However, a reduction in the density of stands and especially clear cuts, promotes the release of soluble nutrients and their discharge by an increased surface runoff and subsurface flow. Fertilization of forest stands may undesirably increase eutrophication of lakes and streams, especially when aerial broadcast includes water basins and riparian zones. Fish kills and other detrimental effects of eutrophication were recorded as consequences of forest fires followed by torrential rains. A great threat to forest lakes is presented by human wastes contributed directly by the vacationists and by seepage of septic tanks. (See Vol. 3, No. 10, Field 5C, W70-03975). (Wilde-Wisconsin)
W70-04505

ALGAE AND METROPOLITAN WASTES.
Public Health Service, Cincinnati, Ohio. Div. of Water Supply and Pollution Control; and Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.

Transactions of seminar on Algae and Metropolitan Wastes held at Cincinnati, Ohio, April 27-29, 1960, sponsored by Div of Water Supply and Pollution Control and the Robert A Taft Sanitary Engineering Center. Bartsch, Alfred F, Chairman. Robert A Taft Sanitary Engineering Center, SEC TR W61-3, 1961. 162 p.

Descriptors: *Conferences, *Eutrophication, *Algae, Planning, Rivers, Lakes, Limnology, Wisconsin, Urbanization, Connecticut, Oregon, Washington, Primary productivity, Ecosystems, Illinois, Phosphorus, Drainage, Agricultural watersheds, Nitrogen fixation, Cyanophyta, Sewage effluents, Minnesota, Water pollution effects, Algicides, Water quality.
Identifiers: *Urban wastes, Madison (Wis), Lake Zoar (Conn), Klamath Lake (Ore), Lake Washington (Wash), Algal nutrition, Algal physiology, Heterotrophy, Micronutrients, Badfish River (Wis), Detroit Lakes (Minn), Nutrient removal, Mass communication.

In April 1960, a seminar met in Cincinnati, Ohio, to consider the problem, Algae and Metropolitan Wastes. The meeting, of which this volume constitutes the recorded transactions, was sponsored by Division of Water Supply and Pollution Control and Robert A Taft Sanitary Engineering Center, both agencies of the US Public Health Service. Discussions at the seminar were limited to prevention and control of objectionable algal blooms arising from enrichment of the hydrosphere by urban and other wastes. The conference was organized into panel discussions as follows: Statement of the Problem, Growth Characteristics of Algae, Sources of Nutrients, Methods of Prevention or Control. Topical coverage of sections, with number of contributions to each recorded in parentheses, will indicate scope and coverage of meeting: introduction (1); specific problems in lakes (4), and in rivers (1); algal nutrition (3); measurement of productivity (2); land drainage (2); wastes (1); limnological relationships (3); nutrient limitation (6); algicide use (1). The volume includes a summation of research needs and text of a banquet address by a journalist on theme of communication between scientist and layman. (See also W70-04507). (Eichhorn-Wisconsin)
W70-04506

BIOLOGICAL PROBLEMS IN WATER POLLUTION.

Tarzwell, Clarence M (editor). Third seminar, 1962. Robert A Taft Sanitary Engineering Center, Cincinnati, Ohio, Public Health Service Publication No 999-WP-25, 1965. 424 p.

Descriptors: *Conferences, *Water pollution, *Aquatic environments, Shrimp, Crabs, Tubificids, Water quality, Bioindicators, Bioassays, Environmental effects, Ohio, Phytoplankton, Eutrophication, Aquatic insects, Invertebrates, Fish, Wildlife, Radioisotopes, Food chains, Toxicity, Organic pesticides, Fish diseases, Fish parasites, Fishkill, Diatoms, Cyanophyta, Aquatic bacteria, Protozoa, Crustaceans, Mollusks, Lakes, Rivers, Copper, Cesium, Dissolved oxygen, Effluents, Columbia River, Land use, Agricultural wastes.
Identifiers: *Water quality criteria, Italy, Marine environments, Freshwater environments, Cincinnati (Ohio), US Public Health Service, Microbial ecology, Zinc, Thermal effects.

This volume records proceedings of Third Seminar on Biological Problems in Water Pollution. Held in August 1962 at Robert A Taft Sanitary Engineering Center, Cincinnati, Ohio, it was sponsored by Research Branch, Division of Water Supply and Pollution Control, US Public Health Service. Seminar's theme was water quality criteria for aquatic life. Organized into sections, with numbers of individual contributions to each recorded in parentheses, sectional topics reflect report's scope: value and use of water quality criteria (5); environmental requirements and effects on water quality of planktonic algae (4); environmental requirements of freshwater invertebrates (4), marine invertebrates (4), aquatic insects (5), fishes and wildlife (8); concentration by aquatic organisms of radionuclides, their passage through food chains and potential effects (4); bioindicators of pollution (3); detection, measurement, toxicity of organic pesticides (5); relationships of land use to hydrosphere (3); control of fish diseases and parasites (2); causes of fishkills (2); artificial eutrophication of hydrosphere (2); safe levels of pollutants and toxicants in hydrosphere (12). Publication includes summary, and text of address--Role of the Aquatic Biologist in the Federal Water Pollution Control Program, by James M Quigley, then Assistant Secretary of US Department of Health, Education, and Welfare. (See also W70-04509 and W70-04510). (Eichhorn-Wisconsin)
W70-04508

THE EUTROPHICATION OF LAKES AND RIVERS, CAUSE AND PREVENTION,
Zurich Univ. (Switzerland). Cantonal Lab.
Eugene A. Thomas.
Third seminar, 1962. Biological Problems in Water Pollution, Robert A Taft Sanitary Engineering Center, Cincinnati, Ohio, Public Health Service Publication No 999-WP-25, p 299-305, 1965. 24 ref.

Descriptors: *Lakes, *Rivers, *Sewage effluent, Water quality control, Nitrogen, Phosphorus, Lake morphology, Color, Turbidity, Dissolved oxygen, Biological treatment, Aquatic plants, Aesthetics, Fishing harvest, Aeration, Cyanophyta.
Identifiers: *Artificial eutrophication, *Phosphorus removal, Sources of pollution, Mechanical treatment, Coregonen, Cladophora, Spirogyra, Ulothrix, Reeds, Oscillatoria limosa, Hydrodictyon reticulatum, Lake Zurich (Switzerland), Circular drainage systems, Plant removal, Chemical treatment, Pumping hypolimnion.

The consequences of sewage added to lakes and rivers is discussed together with the necessary conditions for permanent improvement of waters. Over-enrichment of lakes and rivers occurs by means of sewage effluents even after mechanical and biological purification. Thorough removal of phosphates from sewage as a direct measure against eutrophication is proposed. Other deterrents of eutrophication are prevention of sewage discharge to lakes through circular drainage systems, intensive development of fishing, plant removal, chemical treatment of waters, aeration of deep waters, drawing off deep waters in lakes, and introducing fresh water to deoxygenated waters. (See W70-04508). (Ketelle-Wisconsin)
W70-04509

ALGAE AS INDICATORS OF POLLUTION,
Academy of Natural Sciences of Philadelphia, Pa. Dept. of Limnology.
Ruth Patrick.
Third seminar, 1962. Biological Problems in Water Pollution, Robert A Taft Sanitary Engineering Center, Cincinnati, Ohio, Public Health Service Publication No 999-WP-25, p 225-231, 1965. 4 fig, 1 tab, 33 ref.

Descriptors: *Algae, *Bioindicators, *Water pollution, Diatoms, Maryland, Pennsylvania, Rivers, Streams, Euglena, Aquatic populations, Eutrophication, Cyanophyta, Sewage effluents, Chlorophyta, Rhodophyta, Physiological ecology, Industrial wastes, Hydrogen ion concentration, Iron compounds, Hydrogen sulfide, Lead, Copper, Ammonia, Conductivity, Chromium, Phenols, Nitrogen, Calcium, Dissolved oxygen.
Identifiers: Community structure, Ridley Creek (Pa), Nobs Creek (Md), Back River (Md), Oscillatoria, Catherwood diatometer, Savannah River, Population dynamics, Algal communities, Microbial ecology, Water quality criteria, Cyanide, Naphthenic acid.

Extensive literature has developed regarding algal indicators of pollution. Pollution concept refers to various physical and chemical changes in the hydrosphere produced by human activities. Earliest recognizable form of pollution resulted from organic contamination, and species were classified according to degrees of organic pollution they tolerated. Little attention was focused on population dynamics of various species or on holistic aspects of algal communities. Because of increasing diversity and complexity of pollutional loads and because environment strongly affects their occurrence and population size, assessing pollution by presence or absence of a few species is inclined to be misleading. Thus, well established populations of several algal species may indicate presence of particular forms of pollution, but their elimination or decrease may result from causes very different than changes in pollutional load. Because algal communities integrate effects of influencing factors, more recent study of pollution has been directed to consider structure of the entire algal community as indicative of pollution. Examples are cited of several such approaches, considering various forms of pollution at a number of different localities. Discussion following the paper developed information that Euglena and Oscillatoria are often cited as genera most tolerant to sewage and related conditions. (See W70-04508). (Eichhorn-Wisconsin)
W70-04510

5D. Waste Treatment Processes

PROGRESS AND DEVELOPMENTS IN TREATMENT OF INTEGRATED TEXTILE MILL WASTES,
Colorado State Univ., Fort Collins. Natural Resources Center.
T. A. Alspaugh.
Proceedings 12th Southern Municipal Industrial Waste Conference, North Carolina State Univ, Raleigh, NC, p 46-62, 1964.

Descriptors: *Activated sludge, *Biochemical oxygen demand, *Color, Waste water treatment, Treatment facilities, Aeration, Lagoons, Domestic wastes, Sedimentation, Chlorination, Sludge, Detergents, Spraying, Algae, Centrifugation, Filtration, Anerobic digestion, Incineration, Iron compounds, Sulfates.
Identifiers: *Anti-foam agents, *Textile wastes, Fiber wastes, Dyeing wastes.

A full-scale plant was constructed to treat 21 mil. gal. per week by the 24-hour high-solids activated-sludge process in which the longer aeration period and the higher solids concentrate in the aeration tank both assist in removing the highly-soluble biochemical oxygen demand of textile waste waters, buffering shock loads, and providing efficient treatment as regards removal of color. The textile waste waters pass through two storage lagoons in series (to provide equalization and some removal of lint and dye paste) and are mixed with 10% of screened and degritted domestic sewage before entry into the aeration tank. After final sedimentation the effluent is chlorinated and reacrated before discharge to a creek. Operating data are tabulated showing an average biochemical oxygen demand removal of 89-90% and color removal of 50-75%. The problem of foaming is accentuated by the high concentrate of synthetic detergents in textile waste waters; the most successful treatment methods are spraying with crude waste water, alone or with the addition of anti-foaming agent on to the rotor blades, and possibly the removal and destruction of foam by a vacuum pump. The poorly-settling sludge was found to contain heavy growths of algae. The problem could be overcome by allowing the sludge to become septic before return to the aeration tank, or by introducing a shock load of organic algae. However, these algae have good characteristics for removal of biochemical oxygen demand and color. Excess sludge from the treatment of textile waste waters is difficult to settle and concentrate. Rates of vacuum filtration and centrifugation are low compared with sewage sludge. At present the sludge is discharged to the municipal sewer. Other promising methods of disposal appear to be vacuum filtration and centrifugation. (Livengood-North Carolina State Univ)
W70-04060

NUTRIENT REMOVAL FROM CANNERY WASTES BY SPRAY IRRIGATION OF GRASSLAND,
Robert S. Kerr Water Research Center, Ada, Okla.
James P. Law, Jr., R. E. Thomas, and Leon H. Myers.
Available from the Clearinghouse as PB-189 774, $3.00 in paper copy, $0.65 in microfiche. FWPCA Water Pollution Control Research Series 16080...11/69, Nov 1969. 73 p, 23 tab, 8 fig, 18 ref, 3 append.

Descriptors: *Wastewater treatment, *Soil disposal fields, *Canneries, Industrial wastes, Pollution abatement, Hydrologic aspects, Water conservation.
Identifiers: *Grassland irrigation, *Soil treatment system, Spray-runoff, Cannery waste water, Nutrient removal.

The Campbell Soup Company plant at Paris, Texas, treats wastewater from the processing operations by spraying onto grassland. Vegetable solids and grease residues are separated and recovered. A comprehensive 12-month study was conducted to determine treatment efficiencies of the spray-runoff treatment system. A total of 133 inches of wastewater was applied to four experimental areas during the study period. Hydrological measurements, chemical removal efficiencies, and changes in soil properties were evaluated in relation to years of wastewater application, soil type, and spray schedule. Hydrological measurements accounted for 93 percent of the total liquid applied and showed that evaporative losses accounted for 18 percent of the total liquid applied; runoff accounted for 61 percent. During periods of heavy rainfall, runoff increased to a maximum of 80 percent of the total applied liquid. The results showed that the system achieved mass removals of 92 to 99 percent of the volatile solids and oxygen-demanding substances, 86 to 93 percent of total nitrogen, and 50 to 65 percent of phosphorus. Soil textural class and system age had very little effect on treatment efficiencies. Evaluation of surface and subsoil samples and soil water at the 3-foot depth indicated an increase in salinity with age, but nitrogen and phosphorus remained low. Much of the phosphorus removed from the wastewater was found in the surface soil layer.
W70-04062

DISSOLVED-AIR TREATMENT OF COMBINED SEWER OVERFLOWS, A DEMONSTRATION PROJECT OF A PROTOTYPE TREATMENT PLANT DESIGNED TO TREAT WASTES FOUND AT A COMBINED SEWER OVERFLOW.
Rhodes Technology Corp., Houston, Tex.

Available from the Clearinghouse as PB-189 775, $3.00 in paper copy, $0.65 in microfiche. Federal Water Pollution Control Administration, Research Series, WP20-17, Jan 1970. 216 p, 17 tab, 17 fig, 22 ref, 5 append. FWPCA Program 11020 FKI. Contract No 14-12-11.

Descriptors: *Combined sewers, Storm water, *Overflows, *Dissolved-air flotation, Infiltration, Treatment methods, Primary treatment, Flocculant aide, Suspended solids, Storm runoff.

A dissolved-air flotation system was evaluated for primary treatment of combined sewer overflows. The major pieces of component equipment were a gyratory screen, hydrocyclones, an air dissolving tank, and a flotation cell. The principal aspects investigated were: (1) Performance of the system during rain events and dry periods; (2) Evaluation of individual components; (3) Capital costs and operating costs for utilizing a flotation system for various size combined sewage overflows; (4) The adaptability of the system for automation and use in remote location; and (5) The ability of the system to treat intermittent and highly variable flows from combined sewage systems. Some chemical aids to flocculation were also tested. The system performed comparably to conventional clarifiers. It appears dissolved-air flotation systems would be economical for handling combined sewer overflows up to 8 MGD. Automation of dissolved-air flotation systems appears possible with conventional control equipment. Chemical aids to flocculation appear to have promise that warrants further study. The system was unique in that all liquid flow passed directly through the air dissolving tank with no recycle. Domestic sewage was studied in lieu of combined sewage during periods of no rain. Conclusions, recommendations, and benefit-cost relationships are presented in the report. A description of the demonstration plant and of the drainage area served by the flotation system are appended.
W70-04063

SEWERAGE AND SEWAGE DISPOSAL IN COLD REGIONS,
Army Terrestrial Sciences Center, Hanover, N.H.
Amos J. Alter.
Available from the Clearinghouse as AD-698 452, $3.00 in paper copy, $0.65 in microfiche. Cold Regions Services Engineering Monograph III-C5b, Oct 1969. 110 p. DA Project 1T062112A130.

Descriptors: Frost protection, Lagoons (Ponds), Sewage, *Sewage disposal, *Sewage treatment, Sewers, Utilities (Cold regions), *Waste disposal.

The main items dealt with in this monograph of 106 pages are: Practice and problems, Collection and transport, Treatment and processes, Thermology, Re-use and regenerative processes, and Construction and operation. There are 225 references, 54 illustrations, and 18 tables. Six appendixes treat stabilization ponds, ventilation of buildings having sewage treatment plant, solid wastes, and other topics.
W70-04064

BIOLOGICAL TREATMENT OF HIGHLY-ALKALINE TEXTILE MILL WASTE-SEWAGE MIXTURE.
Proceedings American Society Civil Engineers, Vol 81, No 750, p 750-1--750-4, 1955.

Descriptors: *Biological treatment, *Waste water (Pollution), *Sewage, Alkalinity, Sedimentation, Biochemical Oxygen Demand, Color, Hydrogen Ion Concentration.
Identifiers: *Textile wastes, Percolating filters.

Pilot-plant studies were made on the biological treatment of a mixture of textile manufacture waste waters and sewage on percolating filters, without previous neutralization of the high alkalinity. The waste waters, with a pH value of 10.5, were mixed with sewage in the proportion of 4 percent waste water to 96 percent sewage, the amount of waste water gradually increased to 40 percent, and the mixture applied to the experimental filter at a BOD loading of 2.73 lbs/sq.yd. Examination of the filter effluent showed a reduction in BOD of 51 percent, and in color of 42.5 percent; the pH value was 9.1. A total reduction in BOD of 58 percent was obtained after final sedimentation. (Livengood-North Carolina State Univ)
W70-04084

DEVELOPMENT OF WATER PURIFICATION SYSTEMS BASED ON REVERSE OSMOSIS,
Pratt and Whitney Aircraft, East Hartford, Conn.
For primary bibliographic entry see Field 03A.
W70-04086

BIOLOGICAL TREATMENT OF INDUSTRIAL EFFLUENTS,
N. Blakebrough.
International Dyer, Textile Printer, Bleacher, and Finisher, Vol 135, p 909-911, 1966.

Descriptors: *Biological treatment, *Domestic wastes, *Biochemical oxygen demand, *Treatment facilities, Industrial wastes, Economics, Flow rates, Aeration, Trickling filters, Microorganisms, Organic matter.
Identifiers: Lubeck process.

The Lubeck Process for the biological treatment of wastes sprays effluent tangentially above the surface of a circular aeration tank. (Spraying aerates waste faster and supresses the tendency to foam). The offtake in the center bottom of the tank gives a spiral flow. Air jets and tank construction provide a rolling circulation transverse to the direction of bulk flow; together these flows keep the floc well mixed and suspended. From the aeration tank the effluent goes to a settling tank. The process handles shock loads by diluting through the system and by speeding up the cycling of sludge and liquors. Removal of biochemical oxygen demand is between 88 and 98%. For a given duty, the aeration tank volume for the Lubeck process may be 1/4 to 1/10 that of a conventional plant. Total power requirements for the process are usually between 0.2 - 0.3 kw-hr. per pound of biochemical oxygen demand. (Sheffield - North Carolina State Univ)
W70-04087

METHODOLOGY OF THE ORIENTATION TEST FOR THE AMENABILITY OF WASTE WATERS TO PURIFICATION BY THE ACTIVATED-SLUDGE PROCESS (Czechoslovakian),
A. Borovickova, and V. Zahradka.
Sbornik Vysoke Skoly Chemicko-technologicke v Praze, Vol 8, No 1, p 393-416, 1964.

Descriptors: *Activated sludge, *Biochemical oxygen demand, Industrial wastes, Aerobic bacteria, Microorganisms, Sewage, Copper, Chromium, Phenol, Cotton.
Identifiers: *Dyeing wastes, Warbur-respirometer, Toxicity, Cyanides.

After a comparative review of methods for assessing the effect of trade waste waters (or their toxic constituents) on the aerobic micro-organisms involved in the treatment of municipal sewage by the activated sludge process, the authors describe and explain a direct manometric method developed at the Hydraulic Research Institute, Prague, and based on determination of the oxygen demand in the given substrate using an apparatus of the Warburg-respirometer type. The method and formulae used for calculating the results are explained and experiments showing the effect of copper and hexavalent chromium on the BOD curve for synthetic

municipal sewage and the effects of syanide on the curve for phenolic waste waters. Further studies were also made with cotton-dyeing waste waters and with a mixture of municipal sewage and spent sulphite liquor. In all cases results were confirmed by tests in a laboratory-scale activated-sludge plant. It was concluded that the manometric method gives reproducible biochemical results and indicates objectively the toxicity of the test material towards the aerobic microorganisms. (Livengood-North Carolina State Univ)
W70-04148

FINISHING CHEMICALS FOR KNIT GOODS: SHOULD THEY REALLY BE BIODEGRADABLE,
Fancourt (W. F.) Co., Greensboro, N.C.
R. H. Beaumont.
American Dyestuff Reporter, Vol 54, p P667-P668, 1965.

Descriptors: *Biodegredation, *Biological Oxygen Demand, *Surfactant, Standards, Soaps, Foaming, Bacteria, Detergents.
Identifiers: *Finishing wastes, Knitted fabrics, Textile chemicals.

When an industry empties effluent directly into a stream the replacement of branched-chain detergents with new straight-chain detergents will not produce a low bacterial oxygen demand or reduce the foam problem in the immediate vicinity of the plant. The surfactant that this industry needs is one that decomposes quickly but only to the extent of losing its foam-producing power. If the effluent passes through a treatment system, biodegradables are desirable. The new biodegradable detergents will not behave identically to the non-biodegradable ones in many industrial processes, and adjustments are sometimes necessary. The price of biodegradables is about equal to that of non-biodegradable materials. (Sheffield-North Carolina State University)
W70-04167

COLOR REMOVAL FROM AZO DYE WORKS.

Journal of Sanitary Engineering Division, Proceedings American Society Civil Engineers, Vol 84, No SA2, Paper No 1611, p 1611-1--1611-4, 1958.

Descriptors: *Waste water treatment, Color.
Identifiers: *Dyeing wastes, *Azoic dyes, Chlorine compounds, Tin compounds.

In this report of the Sanitary Engineering Research Committee, Industrial Wastes Section of the American Society of Civil Engineers, the results are given of experiments on the treatment of ten typical azo dyes which are frequently used in the textile industry, with stannous chloride. The color of the dyes was completely destroyed by heating at 212 deg F for 2 hours in the presence of a small amount of stannous chloride. (Livengood-North Carolina State Univ)
W70-04197

DISPOSAL OF WASTES FROM WATER TREATMENT PLANTS.

Am Water Wks Ass'n J, Vol 61, No 11, p 619-638, Nov 1969. 20 p.

Descriptors: *Waste water treatment, *Water treatment, *Waste disposal, *Waste water disposal, Brine disposal, Ultimate disposal, Environmental engineering, Sanitary engineering, Sludge disposal, Lagoons, Water Quality Act, Waste water (Pollution), Sludge treatment, Reclaimed water, Water reuse, Water pollution treatment, Environmental sanitation, Filtration, Oxidation lagoons, Coagulation, Industrial wastes, Municipal wastes, Water softening, Treatment facilities, Water quality control.
Identifiers: *Filter washwater.

A status report on water treatment plant operation is presented. Because of recent federal action and stricter state regulations applying to the discharge of water treatment plant wastes into surface streams, the disposal of such wastes poses a problem of plant operation. Alum coagulant sludge is the prime type of waste produced by water treatment plants. Plant operations for disposal of alum and other coagulant wastes include direct discharge to surface waters, lagooning, discharge to sanitary sewers, freezing, centrifuging, vacuum filtration, sand bed and wedge wire drying, filter pressing, barging to sea, pipeline transportation, and alum recovery. The advantages and disadvantages of each method of disposal are discussed. Filter washwater can be disposed of by treatment and recovery. Methods for disposal of softening plant sludges are generally similar to those used for the disposal of alum sludges. No significant advancements have been made in methods for disposal of the spent brines from cation-exchange softening operations. Ten techniques needed to solve the problem of waste disposal from water treatment plants are suggested. A status report on regulatory aspects of plant waste disposal and a summary of the survey of state regulatory agencies by the American Water Works Association Research Foundation are presented. (Powell-Florida)
W70-04212

WATER, WASTE WATER, AND HEAT IN INDUSTRY (IN GERMAN).

Ciba Ltd., Basle, Switzerland. 71 p, 1961.

Descriptors: *Water supply, *Standards, Waste water treatment, Water treatment.
Identifiers: *Chemical composition, Textile wastes.

A report is given of papers and discussions at a CIBA conference held in Zurich in June, 1961. Subjects dealt with included the collection, composition and treatment of different types of water supply with special reference to the requirements of the textile industry, and the composition and methods of treatment of waste waters from the various processes of the textile industry. The report is illustrated with photographs, plans and diagrams of water supply plant and treatment plant for water waste. (Livengood-North Carolina State Univ)
W70-04218

THE BIOCHEMICAL OXYGEN DEMAND OF TEXTILE CHEMICALS: UPDATED LIST 1966.

American Dyestuff Reporter, Vol 55, No. 18, p 685-688, 1966. 9 ref.

Descriptors: *Biochemical Oxygen Demand, Bio Degredation, Test Procedures.
Identifiers: *Textile Chemicals, Chemical Composition.

Textile chemicals are listed and five-day BOD is given, as determined by the Winkler (Azide Modification) Method found in the 'Standard Methods for the Examination of Water, Sewage, and Industrial Wastes' published by the American Public Health Association. The values are given as percents based on the weight of the chemical as received. The composition and use of each chemical is given. The BOD test is used as an index of pollution and is a good method for the measurement of complete biological decomposition into such compounds as carbon dioxide and water. (Sheffield-North Carolina State Univ)
W70-04240

BIOLOGICAL MEASUREMENT OF WATER POLLUTION,
Beak (T. W.) Consultants Ltd., Collins Bay (Ontario).
T. W. Beak.
Chemical Engineering Progress, Vol 60, No 1, p 39-43, 1964. 5 fig, 10 ref.

Descriptors: *Waste water (Pollution), Water analysis, Measurements, Biology, Microorganisms, Biological properties.

Basic to the biological measurement of pollution is the normal aquatic community with sensitive and tolerant plants and animals in equilibrium. When pollution enters the environment, a degree of change in species composition occurs proportional to the degree of environmental change; the most sensitive species are eliminated first, with tolerant species remaining. The non-numerical nature of biological data has hindered its use in measuring pollution. Two methods are given for putting biological data into a quantitative form. The Biological Score Method establishes normal distribution on control waters and assigns a maximum number of points. Polluted streams are then judged and given a lower number of points in proportion to the amount of pollution present. Scores can be equated to various uses, and differences between two sides of a river or up and down stream can be shown on one chart. The Bivariate Chart Method depends on statistical analysis of biological data on aquatic animal communities to make control charts for detecting significant change in the community and monitoring pollution. (Sheffield-North Carolina State Univ)
W70-04241

TREATMENT OF MIXTURES OF TEXTILE WASTE AND DOMESTIC SEWAGE,
Cone Mills Corp., Greensboro, N. C.
R. H. Souther, and T. A. Alspaugh.
American Dyestuff Reporter, Vol 47, No 14, p 480-488, 490, 1958. 1 fig, 18 ref, 18 tab.

Descriptors: *Domestic wastes, *Biochemical oxygen demand, Water pollution control, Waste disposal, Cotton, Coagulation, Biological treatment, Hydrogen-ion concentration, Trickling filters, Standards, Toxicity, Waste water treatment.
Identifiers: *Souring waste, *Slashing wastes, *Desizing wastes, *Bleaching wastes, Finishing wastes, Mercerizing wastes, Starch, Wool, Sodium carboxymethylcellulose, Sodium hydroxide.

The treatment of textile waste has long been considered a difficult problem due to variability, strength, and alkaline nature of the waste. Many consultants in the past have stated that combined treatment with sewage was not feasible without expensive chemical pretreatment, and therefore, separate treatment recommendations have prevailed. This paper is a discussion of research at Cone Mills to evaluate combined treatment against separate treatment with and without pretreatment. The methods investigated include physical, chemical, and biological processes, particularly the effect of lagooning as an aid to waste treatment. Conclusions indicate that biological treatment of combined textile waste and domestic sewage without chemical pretreatment is practical and economical. Lagooning can be expected to reduce both initial cost and operating expenses. (Sheffield-North Carolina State Univ)
W70-04243

TREATMENT OF INDUSTRIAL WASTES IN THE UNITED STATES,
Purdue Univ., Lafayette, Ind.
Don E. Bloodgood.
Institute of Sewage Purification Journal and Proceedings, Pt 4, p 359-370, 1958. 14 ref.

Descriptors: *Legislation, *Standards, *Radioactive wastes, *Incineration, Phenol industrial wastes, Lagoons.
Identifiers: Waste water treatment, Recovery (Wastes).

The methods of government control in handling of industrial wastes are listed for the federal government, groups of states that have agreed upon compacts, state governments, sanitary districts or other subdivisions of local communities, and municipal governments. 'Model ordinance' specifications for

municipalities are given. Some assisting agencies and symposia are named. Finally, the following waste problems and disposal methods are discussed: (1) underground disposal, (2) refinery wastes, (3) spray and ridge and furrow irrigation of wastes, (4) phenol recovery, (5) incineration of solid cyanide wastes, (6) metal-plating wastes disposal, (7) low stream flow augmentation, (8) industrial re-use of water, (9) circulating lagoons, (10) methods of dealing with radioactive wastes, and (11) a proposed method for recovery of solids from solutions, especially waste liquors and sludges. (Sheffield-North Carolina State Univ)
W70-04244

POLLUTION CONTROL OF NEW ENGLAND INTERSTATE WATERS,
Joseph C. Knox.
American Dyestuff Reporter, Vol 47, No 14, p 477-479, 491, 1958. 2 tab, 4 ref.

Descriptors: *Domestic wastes, *Biochemical Oxygen Demand, Water Pollution Control, Waste disposal, Cotton, Coagulation, Biological treatment, Hydrogen-ion concentration, Trickling filters, Standards, Toxicity, Waste water treatment.
Identifiers: *Scouring waste, *Slashing wastes, *Desizing wastes, *Bleaching wastes, Finishing wastes, Mercerizing wastes, Starch, Wool, Sodium carboxymethylcellulose, Sodium hydroxide.

The New England Interstate Water Pollution Control Commission administers a compact of seven states for the control of water pollution in the interstate inland and tidal waters of the area. The compact is based on a system of classification of waters according to proposed highest use, with physical, chemical and bacteriological standards established for each class. Commission research showed the textile industry to be the largest contributor of wastes. Textile pollution comes from two sources: natural impurities, highest in woolen mills, and process chemicals. In most plants chemicals account for 80% of BOD, but chemical substitution can often eliminate 50%-90% of this. The paper outlines the criteria used in classification of streams under commission control. (Sheffield-North Carolina State Univ)
W70-04247

COMBINED TREATMENT - BLEACHERY WASTE AND DOMESTIC SEWAGE,
Cannon Mills Co., Kannapolis, N.C.
John L. Brown, Jr.
American Dyestuff Reporter, Vol 47, No 14, p 489-490, 1958. 1 ref.

Descriptors: *Domestic wastes, *Biochemical Oxygen Demand, Water Pollution Control, Waste disposal, Cotton, Coagulation, Biological treatment, Hydrogen-ion concentration, Trickling filters, Standards, Toxicity, Waste water treatment.
Identifiers: *Scouring waste, *Slashing wastes, *Desizing wastes, *Bleaching wastes, Finishing wastes, Mercerizing wastes, Starch, Wool, Sodium carboxymethylcellulose, Sodium hydroxide.

Cannon Mills Company segregates waste into starches, caustic wastes, and general wastes. The first two contribute most to pollution and are treated; general wastes are by-passed. Treatment involves (1) segregation, (2) storing caustic wastes, (3) treating waste through a conventional two-stage, high-rate trickling filter plant, and (4) chlorination. The storage lagoon for caustic wastes enables pH control through the plant on a seven-day basis: converts 65% of the hydroxide alkalinity to carbonate or bicarbonate, and reduces BOD 15%. Starch wastes are settled separately, and lime is added to prevent fermentation. Domestic sewage and slasher waste enter the caustic wastes in primary settling tanks, where remaining alkalinity is removed. Four fans blow under the drain system of the filters, eliminating odor and increasing filter efficiency 30%. Chlorine is added at up to 3000 pounds per day, depending on stream condition. Sludge is removed from digestors weekly. The plant treats 60% textile waste and 40% domestic sewage; the operator can control flow rates, pH, and biological load. (Sheffield-North Carolina State Univ)
W70-04248

TREATMENT OF MUNICIPAL WASTES,
Minnesota Univ., Minneapolis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05C.
W70-04274

LABORATORY STUDIES ON THE REMOVAL OF PHOSPHATES FROM SEWAGE BY THE COAGULATION PROCESS,
Norsk Institutt for Vannforskning, Blindern.
Arne Henriksen.
Schweizerische Zeitschrift fur Hydrologie, Vol 24, p 253-271, 1962. 9 fig, 1 tab, 19 ref.

Descriptors: *Sewage, *Sewage treatment, Hydrogen ion concentration, Phosphates, Phosphorus compounds, Coagulation, Detergents.
Identifiers: Orthophosphates, Polyphosphates, Hydrolyzable phosphate, Aluminum sulfate, Ferric sulfate, Molar capacity, Langmuir adsorption isotherm.

Removal of phosphates from sewage by coagulation was accomplished in an apparatus similar to that designed by Packham. Samples of settled sewage of pH 7.8, containing 11.45 milligram/liter phosphate as orthophosphate and 5.75 milligram/liter phosphate as hydrolyzable phosphate, were coagulated with 50 and 200 ppm aluminum sulfate and 40 and 200 ppm ferric sulfate. After filtration the samples were analyzed for orthophosphates. Using aluminum sulfate, an effective removal of orthophosphates was obtained at the pH range 6.0-7.1; the corresponding range with ferric sulfate was 4.7-7.4. Trials with different concentrations of chemicals and addition of acetic acid indicated that ferric sulfate is a more efficient coagulant, especially applicable to hydrolyzable phosphates. A significant part of the latter is represented by polyphosphates from synthetic detergents. Under conditions of these trials, polyphosphates appear to be more vulnerable to removal than orthophosphates. (Wilde-Wisconsin)
W70-04289

REGENERATION OF SPENT GRANULAR ACTIVATED CARBON,
MSA Research Corp., Callery, Pa.
A. J. Juhola, and F. Teppar.
Available from the Clearinghouse as PB-189 955, $3.00 in paper copy, $0.65 in microfiche. Robert A. Taft Water Research Center Report No TWRC-7 Federal Water Pollution Control Administration, Feb 1969. 91 p, 18 fig, 28 tab, 5 ref, 2 append. FWPCA Project 11020...2/69. Contract No 14-12-107.

Descriptors: *Activated carbon, *Tertiary treatment, *Treatment facilities, Waste water treatment, Water purification, Research and development.
Identifiers: Activated carbon regeneration.

The regeneration of spent granular activated carbon, used in tertiary treatment of municipal waste water, is a three-step process, (1) drying, (2) baking and (3) activating. Laboratory studies with an indirect heated rotary tube furnace demonstrated that the rates at which the drying and baking steps are performed do not have a significant effect on the properties of the baked carbon. The controlling step for the regeneration product is the activation, and the important parameters are the carbon temperature, length of activating time, and steam or carbon dioxide concentration in the activating gas mixture. In multiple hearth furnace regenerations, where the reported carbon losses are 5% to 7% per regeneration, the characteristics of the activating step are: (1) high activating gas input rate, (2) relative short activating time, and (3) relatively low carbon temperature. Thermodynamic calculations made on the hearth furnace regeneration indicate that, by performing only the activation of a previously baked carbon, the hearth furnace gas input rate can be reduced drastically and to the point where it approaches the optimum rate of the rotary tube. (Knapp-USGS)
W70-04297

COST AND PERFORMANCE ESTIMATES FOR TERTIARY WASTEWATER TREATING PROCESSES,
Robert A. Taft Water Research Center, Cincinnati, Ohio.
Robert Smith, and Walter F. McMichael.
Available from the Clearinghouse as PB-189 953, $3.00 in paper copy, $0.65 in microfiche. Robert A. Taft Water Research Center Report No TWRC-9, Federal Water Pollution Control Administration, June 1969. 27 p, 7 fig, 6 tab, 5 ref. FWPCA Project 17090...6/69.

Descriptors: *Tertiary treatment, *Water costs, *Cost analysis, *Performance, Activated carbon, Oxidation, Filtration, Sewage treatment, Waste treatment, Water pollution control.
Identifiers: Lime clarification, Ammonia stripping, Microscreening.

Generalized estimates of both performance and cost are presented for wastewater treatment processes which can be used with activated sludge process to reduce the pollution load on the receiving stream. Processes and groups of processes believed to be leading candidates for use downstream of secondary treatment are listed. Data from various sources on the fraction of 5-day BOD associated with suspended solids are tabulated. Microscreening or rapid sand filtration removes about 42% of the 5-day BOD and 21% of the COD and TOC. Other solids-removing processes, such as lime clarification, multimedia filtration, and granular carbon adsorption, remove a greater fraction of the suspended solids. Some of the dissolved organic contaminants might be removed, but this appears to be negligible. A large fraction of the dissolved organic species is removed by granular carbon adsorption. Estimates of the concentrations of BOD, COD, TOC, nitrogen, and phosphorus downstream of each group of processes are tabulated. Estimated capital and operating and maintenance costs for each process are shown. (Knapp-USGS)
W70-04298

ARTIFICIAL-RECHARGE EXPERIMENTS UTILIZING RENOVATED SEWAGE-PLANT EFFLUENT - A FEASIBILITY STUDY AT BAY PARK, NEW YORK, U.S.A.,
Geological Survey, Mineola, N.Y.
Philip Cohen, and C. N. Durfor.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 193-199, 1967. 7 p, 4 fig, 3 ref.

Descriptors: *Artificial recharge, *Recharge wells, *Water reuse, *New York, *Saline water intrusion, On-site tests, Tertiary treatment, Filters, Groundwater movement, Injection wells, Observation wells, Costs.
Identifiers: Long Island (NY), Barrier injection wells.

The U.S. Geological Survey, in cooperation with the Nassau County Department of Public Works, is conducting a series of artificial-recharge experiments on Long Island, New York to obtain scientific and economic data needed to evaluate the feasibility of injecting highly treated sewage-plant effluent into a proposed network of 'barrier' injection wells that are intended to prevent or retard the landward movement of salty water from the Atlantic Ocean into major aquifers. Tertiary sewage treatment was developed to produce an effluent that meets requirements commonly accepted for potability. An experimental injection well and injection plant have been completed. Remote sensing downhole geochemical probes permit the measure-

ment of water-quality and hydraulic-head changes at several points within the injection well and the filterpack. (Knapp-USGS)
W70-04355

METHOD FOR THE REMOVAL OF SOLUBLE PHOSPHATES IN WASTE WATER TREATMENT,
Allied Chemical Corp., New York.
John C. Eck, and William C. Zegel.
US Patent 3,453,207, July 1, 1969, 5 p. 1 tab, 2 ref.

Descriptors: *Waste water treatment, *Phosphates, *Cation exchange, Emulsifiers, Patents.
Identifiers: *Alum, Soluble phosphates, Synthetic cationic organic latex, Polymerization, Olefins, Dienes, Halogen, Copolymerization.

This invention relates to precipitation of dissolved phosphate ion in water by a combination of alum and a cationic organic latex followed by separation of the substantially free water from the phosphate-containing precipitate. 'Synthetic cationic organic latex' contemplates a water based emulsion formed by a free radical emulsion polymerization of 2-carbon to 30-carbon olefins, 4-carbon to 30-carbon dienes and halogen, ester or aryl substituted olefins or dienes of the above chain length or mixtures thereof with each other in water and a cationic organic emulsifying agent. Only limitation imposed is that resultant polymer or copolymer must be water soluble. Preferable compounds for the preparation of the lattices along with several illustrative examples are described. Data from 17 runs indicates that treatment of wastewater by the simultaneous addition of 10 ppm of a variety of lattices and 40 ppm of alum is as effective at removing dissolved phosphate as treatment with 150 ppm of alum alone. Treatment of wastewater with cationic latex effects essentially no phosphate removal. Treatment with 40 or 50 ppm of alum alone is significantly less effective than treatment with the synergistic combination of 40 ppm of alum and 10 ppm of latex. (Haskins-Wisconsin)
W70-04463

THE EUTROPHICATION OF LAKES AND RIVERS, CAUSE AND PREVENTION,
Zurich Univ. (Switzerland). Cantonal Lab.
For primary bibliographic entry see Field 05C.
W70-04509

5E. Ultimate Disposal of Wastes

SEWERAGE AND SEWAGE DISPOSAL IN COLD REGIONS,
Army Terrestrial Sciences Center, Hanover, N.H.
For primary bibliographic entry see Field 05D.
W70-04064

DISPOSAL OF LIQUID WASTES BY INJECTION UNDERGROUND - NEITHER MYTH NOR MILLENNIUM,
Geological Survey, Carmel, Calif.
Arthur M. Piper.
Report available at no cost from US Geological Survey, Wash, DC 20242. Geological Survey Circular 631, 1969. 15 p, 2 tab, 94 ref.

Descriptors: *Waste disposal, *Injection wells, *Well regulations, Aquifers, Water quality, Earthquakes, Water storage, Water pollution sources, Water pollution control, Surveys, Legislation, Legal aspects, Economics, Regulation, Administrative agencies, Management.
Identifiers: Waste disposal wells.

Injecting liquid wastes deep underground is an attractive but not necessarily practical means for disposing of them. For decades, impressive volumes of unwanted oil-field brine have been injected, currently about 10,000 acre-feet yearly. Recently, liquid industrial wastes are being injected in ever-increasing quantity. Effects of deep injection are complex and not all are understood clearly. In a responsible society, injection cannot be allowed to put wastes out of mind. Injection is no more than storage--for all time in the case of the most intractable wastes--in underground space of which little is attainable in some areas and which is exhaustible in most areas. Standards by which to categorize the wastes are urgently desirable. To the end that injection may be planned and administered, there is proposed an immediate and comprehensive canvass of all the United States. Such a canvass would consider (1) natural zones of groundwater circulation, from rapid to stagnant, (2) regional hydrodynamics, (3) safe injection pressures, and (4) geochemical aspects. Only Missouri, Ohio, and Texas have statutes specifically to regulate injection of industrial wastes. Some new, fully competent institutional arrangement appears to be essential, under a unified policy. (Knapp-USGS)
W70-04103

DISPOSAL OF WASTES FROM WATER TREATMENT PLANTS.
For primary bibliographic entry see Field 05D.
W70-04212

ANIMAL WASTE DISPOSAL PROBLEMS AND TRENDS IN MINNESOTA,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 05C.
W70-04270

MANAGING LIVESTOCK WASTES TO CONTROL POLLUTION,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 05C.
W70-04271

5F. Water Treatment and Quality Alteration

REGIONAL CONSTRUCTION REQUIREMENTS FOR WATER AND WASTEWATER FACILITIES.
Business and Defense Services Administration, Washington, D.C.

Available from the US Dept of Commerce, Wash, DC, 20230, price - $0.25. US Department of Commerce, Business and Defense Services Administration, Oct 1967. 35 p, 22 fig, 18 tab, 7 map, 9 ref.

Descriptors: *Water supply, *Waste water (Pollution), *Waste water treatment, *Costs, Construction, Water quality, Construction costs, Installation costs, Maintenance costs, Replacement costs, Obsolescence.
Identifiers: *Water facilities, *Wastewater facilities.

The purpose of this report is to serve as a guide and to assist manufacturers in planning their future production and sales programs. It can also be used to advantage by construction contractors, consulting engineers and federal, state and local planners. This study provides historical data of construction put in place in actual dollars from 1955 through 1966, and a projection of requirements in 1966 dollars from 1967 through 1980. Since World War II the increase in population, with its attendant tremendous urban expansion accompanied by population shifts in the United States, has stimulated a greater demand for public water and wastewater facilities. At 1966 prices, an estimated $66.3 billion must be spent on construction of water ($28.8 billion) and wastewater facilities ($37.5 billion) during the 14-year period 1967-1980. This sum is required to remedy present deficiencies, to make up for obsolescence and depreciation, and to meet increased requirements of a growing population. The increase in water usage and wastewater discharge will require an average annual expenditure at $4.7 billion for the 14-year period for water and wastewater facilities ($2.0 billion and $2.7 billion respectively). This is an increase of approximately 139% of the annual average expenditure over the past 12 years. (Davis-Chicago)
W70-04168

GRAVITY FILTRATION OF ALGAL SUSPENSIONS,
Ontario Water Resources Commission, Toronto. Div. of Research.
R. H. G. Andrews.
Ontario Water Resources Commission, Division of Research Publication No 21, Aug 1968. 41 p, 22 fig, 6 tab.

Descriptors: *Water, *Filters, *Algae, Nuisance algae, Intakes, Sands, Flow rates, Turbidity, Chlorella, Scenedesmus, Euglena.
Identifiers: *Water supplies, Green algae, Head losses, Oocistus, Filtration media, Anthracite, Gravity filters.

This study was concerned with effectiveness of different filter media preventing the clogging of water supplies by algae: Chlorella, Scenedesmus, Oocistus, and Euglena. The dual-media and anthracite filters proved comparatively most effective, but their maximum retention was only 50% of Euglena and 18% of other algae. There was no consistent effect of the rate of flow on algae removed. The use of nephelometric turbidimeter failed to provide a significant correlation between algae counts and recorded turbidities. The conclusion is that gravity filters alone should not be considered for removal of algae from raw water supplies. (Wilde-Wisconsin)
W70-04199

POLICE AND HEALTH REGULATIONS OF FOURTH CLASS CITIES.

Mo Ann Stat secs 79.380, 79.390 (1952), as amended, (Supp 1970).

Descriptors: *Missouri, *Cities, *Public health, *Diseases, Legislation, Local governments, Parks, Condemnation, Regulation, Water works, Hospitals, Sewers, Conduits, Outlets, Channels, Channel improvement, Wells, Reservoirs, Well regulations, Well permits, Reservoir management, Water supply, Cisterns, Water pollution, Diversion, Obstruction to flow.

The board of aldermen of fourth class cities may make regulations and enact ordinances for the prevention and abatement of contagious diseases within the city. Quarantine laws may be enforced within five miles of the city. The board may purchase or condemn all necessary lands within ten miles of the city for hospital purposes, waterworks, and sewer carriage and outfall. The police jurisdiction of the city shall extend over such land to the same extent as over other city property. The board may establish, alter, and change the channel of watercourses, wall them and cover them over, and prevent obstructions thereon. They may establish and regulate public wells, cisterns, and water reservoirs. They may provide for the filling of such water reservoirs. (Schram-Florida)
W70-04231

REGENERATION OF SPENT GRANULAR ACTIVATED CARBON,
MSA Research Corp., Callery, Pa.
For primary bibliographic entry see Field 05D.
W70-04297

ARTIFICIAL RECHARGE FOR PUBLIC WATER SUPPLIES IN URBANIZED REGIONS,
Technische Hogeschool, Delft (Netherlands). Dept. of Sanitary Engineering.
L. Huisman.

Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 200-212, 1967. 13 p, 17 fig, 2 tab.

Descriptors: *Artificial recharge, *Municipal water, *Water storage, *Water quality, Water treatment, Filtration, Public health, Water purification, Water resources, Water spreading, Aquifers, Permeability, Porosity.
Identifiers: *Netherlands.

Artificial recharge is applied to transform surface water with varying characteristics into groundwater of more constant quality, which will be safe for public supply. The utmost stress is put on the removal of bacteriological pollution, for which purpose the recharge and recovery works are designed and operated in such a way as to avoid short-circuiting as much as possible. This results in a more or less constant detention period for all the water abstracted and consequently variations in physical and chemical characteristics of the raw water are propagated with little or no damping. Input variation, as well as fluctuation in water temperature, could be smoothed out by a different design of the artificial recharge system, promoting a strong variation in detention time and -- if necessary -- even accepting short-circuiting. A few suggestions are given for possible solutions. As an example, the use of water from the River Rhine for public drinking water supplies in the Netherlands is considered. (Knapp-USGS)
W70-04356

CHICAGO'S SOUTH DISTRICT FILTRATION PLANT.
Department of Water and Sewers, Chicago, Ill.

Chicago, City of Chicago Department of Water and Sewers, 1961. 29 p, 25 fig, 3 tab.

Descriptors: *Water treatment, *Water purification, *Filtration, *Filters, *Water supply, *Water works, *Treatment facilities, Chemical precipitation, Coagulation, Chlorination, Sedimentation, Ammonification, Activated carbon, Construction, Construction materials, Construction costs, Intakes, Tunnels.
Identifiers: *Chicago Water Department, *Chicago's South District Filtration Plant.

The publication describes the design, construction and operation of Chicago's South District Filtration Plant which went into full operation in 1947. The plant, located at Lake Michigan near East 79th St., serves about 1,600,000 persons in a 162 Sq. Mi. area. Two raw water intakes are provided--one crib intake located 2 miles offshore, and a direct intake at the lake end of the plant. Water entering the crib intake is conveyed by 14 Ft. and 16 Ft. diameter tunnels located 140 Ft. below lake level. A breakwater was built to protect plant structures from wave action, and a watertight bulkhead was built around the plant area. The mixing and settling basins are of two-story construction. A portion of the filtered water storage is located below the filters. The treatment process consists of prechlorination, addition of activated carbon, coagulation with aluminum sulfate or ferrous sulfate, fluoridation, sedimentation, filtration, and postchlorination with ammoniation. Maximum plant capacity is 640 mgd; 1960 average was 365 mgd. Construction cost, including engineering and supervision, was $27,052,932. One hundred seventy two employees are used to operate the plant. (Poertner-Chicago)
W70-04437

PRODUCTION OF CHANNEL CATFISH (ICTALURUS PUNCTATUS) IN TERTIARY TREATMENT PONDS,
Iowa State Univ., Ames. Dept. of Zoology and Entomology.
Thomas G. Huggins, and Roger W. Bachmann.
Available from the Clearinghouse as PB-190 165, $3.00 in paper copy, $0.65 in microfiche. Iowa State Water Resources Research Institute, Completion Report Project No A-017-IA, June 1969. 119 p, 21 fig, 38 tab, 35 ref. OWRR Project A-017-IA.

Descriptors: *Channel catfish, *Tertiary treatment, *Ponds, Water quality, Temperature, Light penetration, Dissolved oxygen, Ammonia, Nitrates, Nitrites, Phosphates, Chemical oxygen demand, Biochemical oxygen demand, Phytoplankton, Zooplankton, Benthic fauna, Hydrogen ion concentration, Ammonia, Diurnal distribution, Chlorophyll, Chlamydomonas, Chlorella, Copepods, Rotifers, Tubificids, Pollution abatement, Stocking, Midges, Seasonal, Depth, Chemical analysis, Scenedesmus, Euglena, Ochromonas, Nematodes, Mites, Insects.
Identifiers: *Ictalurus punctatus, Ames (Iowa), Ankistrodesmus, Pandorina, Cladocerans, Physa halei, Chironomids, Glyptotendipes barbipes, Chlorogonium, Actinastrum, Golenkinia, Kirchneriella, Micractinium, Oocystis, Pediastrum, Chroomonas, Cryptomonas, Navicula, Nitzschia, Glossiphoniidae, Palpomyia.

A series of four tertiary treatment ponds, studied for water quality improvement and channel catfish production, provided data on water temperature, light penetration, dissolved oxygen, ammonia, nitrate, nitrite, ortho phosphate, chemical oxygen demand, biochemical oxygen demand, phytoplankton, zooplankton, benthic fauna and channel catfish. Thermal and chemical stratification disappeared after installation of an aeration system. Average reduction in nitrate and nitrite concentration from the plant effluent to pond IV was 27% during the 1967 winter and 70% during the 1968 summer. During the 1967 winter a slight increase in ortho phosphate concentration was recorded from treatment plant effluent to pond IV but during the 1968 summer there was a reduction of 48%. Dominant genera were usually Chlamydomonas, Ankistrodesmus, Chlorella, and Pandorina in pond IV. Average concentration of chlorophyll a in ponds III and IV was similar both summers but in ponds I and II much less for the 1968 summer. Cladoceran populations were greater in pond I during the 1968 summer than during the 1967 summer. Chironomids were the dominant organisms in benthos. During the 1967 summer, catfish grew well in ponds III and IV. Catfish survival, growth and production progressively increased from pond I to pond IV. (Jones-Wisconsin)
W70-04445

IMPOUNDMENT DESTRATIFICATION FOR RAW WATER QUALITY CONTROL USING EITHER MECHANICAL OR DIFFUSED AIR PUMPING,
Federal Water Pollution Control Administration, Cincinnati, Ohio.
J. M. Symons, W. H. Irwin, E. L. Robinson, and G. G. Robeck.
J. American Water Works Assoc., Vol 59, No 10, p 1268-1291, October 1967. 20 fig., 5 tab., 19 ref.

Descriptors: *Thermal stratification, *Aeration, *Impoundments, *Reservoirs, *Mixing, *Water quality control, Water quality, Water pollution, Nitrogen, Phosphorus, Air, Phytoplankton, Algae, Efficiencies, Dissolved oxygen, Oxygen, Lakes.

Two methods are compared for artificially destratifying lakes and reservoirs both of which broke up the thermal stratifications pattern in the lakes successfully and improved water qualities. Other conclusions reached were that multiple mixing started in the spring will maintain good quality water in an impoundment, and is superior to a single mixing in midsummer or early fall. Some rise in nitrogen and phosphorus concentrations occurred in surface water during destratification, but the surface population of phytoplankton and the phytoplankton standing crop declined during mixing. Algal populations increased again when mixing stopped. Data taken in this study and from 5 other studies in the literature showed a destratification efficiency ranging from 0.1 to 1.2%, and averaging 0.5%; and an energy input/unit of impoundment water volume ranging from 0.7 to 4.9 kw-hr/acre ft and averaging 2 kw-hr/acre-ft. (Novotny-Vanderbilt)
W70-04484

5G. Water Quality Control

PROJECTS OF THE INDUSTRIAL POLLUTION CONTROL (BRANCH FEDERAL WATER POLLUTION CONTROL ADMINISTRATION),
Federal Water Pollution Control Administration, Washington, D.C.
William J. Lacy.
Available from the Clearinghouse as PB 189 766, $3.00 in paper copy, $0.65 in microfiche. Up-dated version of report with same title of August 1969 (See Vol 3, No 6, W70-02885). FWPCA Water Pollution Control Research Report, Jan 1970. 167 p, 9 tab, 4 fig. FWPCA Project 12000---01/70

Descriptors: *Industrial water, *Water pollution control, Wastewater treatment, *Water reuse, *Water pollution treatment, Industries, Water quality, Water requirement.
Identifiers: Industrial pollution control.

The objective of the industrial pollution control R and D program is to develop and demonstrate the required technology to achieve required degrees of pollution control by lease cost methods for all significant industrial sources of pollution. This report includes summaries of 150 research, development, and demonstration efforts necessary to resolve industrial pollution problems. A total of 1200 program efforts are listed in tabular presentation. These projects include the latest developments in physical, chemical, biological and combinations of treatment methods. It is expected to develop further the cooperation of industry to participate in meaningful pollution abatement demonstrations and to increasingly demonstrate the feasibility of in-plant measures, by-product recovery, and wastewater reuse as methods to abate pollution and to reduce treatment costs. Research through in-house efforts and by contracts to industries and universities are to complete state of the art studies related to treatment and control technology for selected industry groups. Research through in-house efforts and by contracts to industries and universities are to complete state of the art studies related to treatment and control technology for selected industry groups. Industrial wastewaters are to be identified, characterized, quantitized, and classified for all industries of pollutional significance.
W70-04045

DISSOLVED-AIR TREATMENT OF COMBINED SEWER OVERFLOWS, A DEMONSTRATION PROJECT OF A PROTOTYPE TREATMENT PLANT DESIGNED TO TREAT WASTES FOUND AT A COMBINED SEWER OVERFLOW.
Rhodes Technology Corp., Houston, Tex.
For primary bibliographic entry see Field 05D.
W70-04063

DELAWARE RIVER BASIN COMPACT.
For primary bibliographic entry see Field 06B.
W70-04081

WATER QUALITY MANAGEMENT, FIRST ANNUAL REPORT FOR PERIOD ENDING JUNE 30, 1969.
Miami Conservancy District, Dayton, Ohio.

Miami Conservancy District First Annual Report of Water Quality Management, Aug 1969. 97 p, 31 fig, 5 exhibit, 17 tab, 44 ref.

Descriptors: *Water pollution control, *Ohio, Water quality act, Aesthetics, Water quality, Water pollution treatment, Monitoring, Planning, Water management (Applied).
Identifiers: *Miami River (Ohio).

The programs and activities of the Miami Conservancy District are described. The purpose of the District's program is to provide for the evaluation of regional water quality in the Great Miami River basin and for the development of regional programs which will enhance and protect the water and related land resources of the basin. Activities being carried out are the formation and utilization of advisory groups, the establishment and operation of a network for monitoring regional stream water quality, and the evaluation of various approaches to improving water quality, such as stream aeration and low-flow augmentation. The plan also provides for continuing surveillance of stream conditions with appropriate notice to individuals and organizations responsible for activities which degrade stream appearance. Reaches of stream which are maintained by The Miami Conservancy District for flood control purposes are receiving more intensive care directed to improving the appearance of the river channels. (Knapp-USGS)
W70-04096

ACID MINE-DRAINAGE PROBLEM OF THE PATOKA RIVER WATERSHED, SOUTHWESTERN INDIANA,
Indiana Univ., Bloomington.
Don M. Corbett.
Water Resources Research Center Report of Investigations No 4, Indiana University, Oct 1969. 173 p, 4 fig, 2 plate, 4 tab, 10 ref.

Descriptors: *Acid mine water, *Indiana, Water pollution sources, Water pollution control, Water pollution treatment, Acidic water, Neutralization, Data collections, Water quality, Leaching, Sulfates, Chlorides.
Identifiers: Patoka River, Pike County (Ind).

Sources of acid in the Patoka River Watershed, Indiana, were identified and the effect this acid had on the water quality of the Patoka River was determined. The economic development of Pike County and adjacent areas has been stymied for more than 30 years because of an inadequate supply of good quality water. The Patoka River (below the mouth of the South Fork Patoka River during periods of low flow, is too acidic for domestic use. Treatment would be beyond the financial resources of the local economy. Of the 20,000 acres of cast overburden groundwater aquifers in Pike County, less than 4,000 acres produce acidic water. The remaining 16,000 acres produce nonacidic water, most of which is high in sulfate, and in some instances, high in chloride. The acid mine-drainage problem of this area is a creation of past mining operations for coal. Acid contributions from storm runoff are usually many times greater than those from sustained flow, and most generally originate in the compacted 5 to 10% of the areas disturbed by surface mining that accelerate runoff. Stabilization of acidic flows at a reduced level, by eliminating flushout of pollutants in the South Fork Patoka River Watershed, would make feasible the treatment of 5,000,000 gpd. (Knapp-USGS)
W70-04097

INVESTIGATION OF SOME METHODS FOR INCREASING THE DIGESTIBILITY IN VITRO OF MICROALGAE,
Royal Inst. of Tech., Stockholm (Sweden). Div. of Applied Biochemistry.
Gudmund Hedenskog, Lennart Enebo, Jitka Vendlova, and Bohumir Prokes.
Biotechnology and Bioengineering, Vol 11, No 1, p 37-51, 1969. 6 fig, 4 tab, 18 ref.

Descriptors: *Algae, *Microorganisms, Scenedesmus, Proteins, Walls, Structure, Amino acids, Mechanical equipment, Enzymes, Chemical degradation, Vitamins, Cellulose, Chlorella, Peptides, Bacteria, Snails, Weight, Vacuum drying, Boiling.
Identifiers: *Digestibility, *In vitro, In vivo, Ball-mill, Meicelase, Hydrogen peroxide, Rats, Trypsin, Scenedesmus quadricauda, Scenedesmus obliquus, Helix pomatia, Chlorella pyrenoidosa, Nitrogen utilization, Roller drying, Spray-dried, Glass beads, Trichoderma, Disintegration.

To increase availability of cell bound protein in Scenedesmus algae, mechanical, enzymatic, and chemical methods of degrading the cell wall structure were investigated. Mechanical treatment involved the use of a ball-mill; algae suspension together with glass beads was milled in a water-cooled chamber equipped with rotating disks. The chemical test included a cellulolytic enzyme (Meicelase) employing hydrogen peroxide. Using batches in the ball-mill experiments a complete disintegration was achieved in a disintegrator. Trials were also performed with a continuous disintegrator and dependence of disintegration on bead size and flow rate studied. Disintegration determined by microscopic cell count was compared to increase of pepsin digestibility. The Meicelase treatment caused a slight increase of pepsin digestibility, measured after 3 hour pepsin incubation. No increase of pepsin digestibility was detected with hydrogen peroxide treatment. After the ball-mill disintegration, 95% of contaminating bacteria were killed and yields of extractable proteins were higher. Capacity of available continuous ball-mills is such that they could be used on a pilot-plant scale and energy cost of disintegration would be of the same magnitude as that of separation. (Jones-Wisconsin)
W70-04184

GEORGIA WATER LAW (WATER POLLUTION IN GEORGIA),
For primary bibliographic entry see Field 06E.
W70-04203

A BOUNTY ON WATER POLLUTERS,
A. R. Roalman.
Water Resources Bulletin, Vol 5, No 2, p 62-65, June 1969. 4 p, 1 ref.

Descriptors: *Water resources development, *Legislation, *Water pollution control, *Pollution abatement, Rivers and Harbors Act, Harbors, Navigable waters, Legal aspects, Government, Water pollution sources, Non-structural alternatives, Environmental sanitation, Remedies.

The Harbor Act of June 29, 1888, as amended on June 7, 1924, could be the most powerful pollution control law on the books. It provides a way for any private citizen to bring an action against almost any water polluter. It includes a stiff fine and a jail sentence for the polluter. It also provides a bounty for the citizen who proves his case. A congressman and a group of New York conservationists have invoked the act in a suit against the Penn-Central Railroad charging pollution of the Hudson River. The Secretary of the Army and the Corps of Engineers of the United States Army are responsible for enforcing the law. The Act originally covered New York Harbor and Long Island Sound. Later amendments expanded it to cover waterways flowing into the Atlantic and the Gulf of Mexico. The most recent amendment extended coverage to the outflow waters of the United States. One contention is that all the navigable waters of the United States are included. The Act strictly forbids the placing, discharging, or depositing, by any process or manner, of refuse, dirt, ashes, cinders, mud, sand, dredgings, sludge, acid, or any other matter of any kind other than that flowing from streets, sewers, and passing therefrom in a liquid state. Another portion of the Act concerns pollution caused by oil spills from ships. (Powell-Florida)
W70-04210

ESTABLISHMENT OF MUNICIPAL SEWER SYSTEMS.
Mo Ann Stat secs 88.832 thru 88.852 (Supp 1970).

Descriptors: *Missouri, *Sewers, *Sewage disposal, *Local governments, Legal aspects, Political aspects, Cities, Sewage, Sewage treatment, Waste water disposal, Wastes, Municipal wastes, Domestic wastes, Municipal water, Environmental sanitation, Treatment facilities, Taxes, Legislation.

Any municipality may establish a general sewer system composed of public, private, district, and joint district sewers. Public sewers shall be established along principal courses of drainage. The municipality may levy a 'special public sewer tax' on all taxable property within the city to pay for construction and maintenance of sewers. District sewers may be established and connected to public sewers upon petition of a majority of the landowners in the district or when the municipality deems such sewer necessary for sanitary reasons. The municipality shall levy a tax apportioning the cost of district sewers among the pieces of ground in the district. Joint district sewers may be established when the municipality deems a sewer in an area encompassing more than one district to be necessary. The municipality may regulate construction of private sewers and shall assume none of the cost thereof. The municipality may condemn and purchase property for construction of sewers. When no bids are offered for sewer construction the city may construct a sewer. (Dye-Florida)
W70-04229

WATER POLLUTION.
Mo Ann Stat secs 204.010 thru 204.180 (1962), as amended, (Supp 1970).

Descriptors: *Missouri, *Water pollution, *Water pollution control, *Administrative agencies, Legislation, Public health, Environmental sanitation, Impaired water quality, Pollution abatement, Pollutants, Pollutant identification, Reasonable use, Riparian rights, Standards, Wastes, Industrial wastes, Sewage, Water pollution treatment, Fish, Wildlife, Recreation, Agriculture, Permits, Water pollution sources, Administrative decisions, Legal aspects.

The state policy toward water pollution is detailed. Pollution is defined as the discharging of sewage or wastes into the state's water so as to make them impure, odorous, detrimental to public health, harmful to fish or wildlife, or detrimental to agricultural, industrial, recreational, or other reasonable uses. Causing pollution is declared a public nuisance and made unlawful. Permits are required prior to discharging sewage or wastes into the state's waters. The Water Pollution Board is authorized to grant and revoke such permits. The Board shall supply technical and scientific information to polluters to aid in eliminating pollution. Hearings and judicial review of Board actions relating to permits are provided. The organization of the Water Pollution Board is outlined. The Board is required to: (1) make surveys to determine the extent of pollution within the state; (2) prepare plans to reduce pollution and prevent further pollutions; (3) establish standards of water purity; and (4) administer the enforcement of pollution laws. The Board may conduct research, cooperate with government agencies, and enter agreements to prevent and control pollution. The Board may investigate violations, institute legal proceedings, make inspections, and represent the state. The powers of drainage and levee districts and the rights of action are not affected by this act. (Schram-Florida)
W70-04237

WATER POLLUTION BY NUTRIENTS-SOURCES, EFFECTS AND CONTROL, PAPERS PRESENTED AT 1966 ANNUAL MEETING OF MINNESOTA CHAPTER SOIL CONSERVATION SOCIETY OF AMERICA.
Minnesota Univ., Minneapolis. Water Resources Research Center.
For primary bibliographic entry see Field 05B.
W70-04266

SETTING WATER QUALITY STANDARDS AND REGULATING NUTRIENT SOURCES,
Minnesota Pollution Control Agency, Minneapolis.

John P. Badalich.
Water Pollution by Nutrients--Sources, Effects and Control, Water Resources Research Center, University of Minnesota, Minneapolis, WRRC Bulletin 13, p 64-72, June 1969.

Descriptors: *Nutrients, *Regulation, Nitrogen, Phosphorus, Water quality control, Waste treatment, Water quality, Minnesota, Eutrophication.
Identifiers: *Nutrient sources, Stream standards, Effluent standards, Stream uses, US Public Health Service, Water quality standards, Areal nutrient sources.

The definition of an acceptable water quality standard is thought to have instigated all the discussion of standards in the past few years. Basis and methodology for establishing water quality standards for Minnesota are discussed. Application of water quality standards in Minnesota is discussed in terms of stream and effluent standards; specific standards are presented. Regulation of nutrient sources is summarized in terms of point sources and areal runoffs. Areal and agricultural runoff contributes the major portion of nutrients. Nuisance blooms of algae are possible at a phosphorus concentration of 0.01 milligram/liter and 0.3 milligram/liter of nitrogen. Minnesota has a phosphorus standard of 1 milligram/liter, which is considered a temporary economically attainable limit for the present, rather than a protective limit. (See W70-04266). (Bannerman-Wisconsin)
W70-04277

EFFECT OF DESASPIDIN AND DCMU ON PHOTOKINESIS OF BLUE-GREEN ALGAE,
Marburg Univ. (West Germany). Dept. of Botany.
W. Nultsch.
Photochemistry and Photobiology, Vol 10, No 2, p 119-123, 1969. 2 fig, 2 tab, 15 ref.

Descriptors: *Cyanophyta, *Light, *Kinetics, Anaerobic conditions, Argon, Photosynthesis, Air, Light quality, Cycles.
Identifiers: *Desaspidin, *DCMU, Phormidium uncinatum, Phosphorylation, Ferricyanide, Electron transport, ATP, Dark, Phycocyanin, Acceleration, Glycolysis, Carbon dioxide-fixation, Phycoerythrin.

Photokinesis (light accelerated movement) is the result of an increased ATP supply of photosynthetic phosphorylation, whereas movement in the dark is supported by ATP produced by oxidative phosphorylation and, to a minute extent, by anaerobic-phosphorylation coupled with glycolysis. Movement speed may be used to measure the activities of phosphorylation processes within the living cell. Effect of desaspidin and DCMU (3-(3,4-dichlorophenyl-1, 1-dimethylurea) on movement speed in light and dark of the blue-green algae Phormidium uncinatum has been investigated. Desaspidin, which uncouples oxidative phosphorylation and predominantly cyclic photosynthetic phosphorylation, inhibits movement in the dark as well as light, but dark movement is more sensitive. Movement in light is more sensitive under anaerobic conditions than in air. Inhibitory effect of desaspidin is markedly increased by DCMU, which inhibits non-cyclic electron transport and coupled phosphorylation in air as well as under argon. There is no evidence of any photodestruction of desaspidin in air, provided no ferricyanide is present in the medium. These findings are interpreted to confirm the concept of photokinesis and that both cyclic and non-cyclic photophosphorylations supply energy for the movement in blue-green algae. (Jones-Wisconsin)
W70-04293

FACTORS AFFECTING THE USE OF MONOMOLECULAR SURFACE FILMS TO CONTROL OIL POLLUTION ON WATER,
Naval Research Lab., Washington, D.C.
William D. Garrett, and William R. Barger.
Environmental Science and Technology, Vol 4, No 2, p 123-127, Feb 1970. 5 p, 4 fig, 3 tab, 17 ref.

Descriptors: *Water pollution control, *Monomolecular films, *Oily water, Water chemistry, Water properties, Water quality, Surfactants, Thin films, Films, Alcohols.
Identifiers: Oil pollution control.

Under suitable conditions, monomolecular surface films may be used to confine oily pollution on water. Since these materials spread spontaneously into one-molecule-thick layers, very small quantities can be used to treat large surface areas. The surface-chemical characteristics of several potential pollutants were studied to determine their behavior at the air/water interface. A number of monolayer-forming materials with varying surface-chemical properties were examined for their ability to survive at an air/water interface and contain oil films. The following monolayer properties relevant to oil pollution control were determined: the monolayer spreading velocity, the ability to resist and spread against wind, and the thickness of an oil lens supportable by a particular monolayer. Optimum characteristics were demonstrated by 'liquid' water-insoluble monolayers with high film pressures and low oil solubility. Surface films with high spreading pressures will compress thinly spread layers of pollutant oil to lenses 0.5-1.0 cm thick, substantially reducing the area covered by pollution. (Knapp-USGS)
W70-04305

ACID MINE DRAINAGE IN APPALACHIA.
Appalachian Regional Commission, Washington, D.C.

Appalachian Regional Commission Report, 1969. 126 p, 4 fig, 10 plate, 37 tab.

Descriptors: *Acid mine water, *Appalachian Mountain Region, *Data collections, *Surveys, Hydrologic data, Water chemistry, Water quality, Hydrogeology, Water pollution sources, Water pollution effects, Water pollution control, Recreation, Navigation, Water sources, Ecology, Economics.
Identifiers: Acid mine drainage data.

Over the last 100 years, coal mining in the Appalachian Region has caused increased amounts of acid, sediment, sulfates, iron, manganese, and hardness in the Region's streams, thus substantially altering water quality in approximately 10,500 miles of streams,primarily in the northern half of the Region. Three-fourths of the acid streams are in the Susquehanna, Allegheny, Monongahela, Potomac, and Delaware River basins in Pennsylvania, West Virginia, and Maryland. Almost 80% of acid pollution comes from abandoned or inactive mines and over 70% originates in underground mines. Cost and extracted waste disposal considerations limit treatment technology applicable for pollution control to the neutralization processes. A concerted effort over a period of time to abate and control acid mine drainage pollution involves determining priorities, providing funding arrangements, implementing abatement programs, regulating active mining operations, continuing research and development of control and abatement techniques, and adequately considering the interests of the various public and private groups involved. Such an effort, to be successful, requires the full participation of Federal, regional, state and local levels of government as well as the private sector in the affected portions of the Region. (See also W70-04329 thru W70-04333). (Knapp-USGS)
W70-04328

THE IMPACT OF MINE DRAINAGE POLLUTION ON INDUSTRIAL WATER USERS IN APPALACHIA,
Battelle Memorial Inst., Columbus, Ohio.
Ira L. Whitman, Gerald I. Nehman, and Syed R. Qasim.
Appalachian Regional Commission Report on Acid Mine Drainage in Appalachia, Appendix A, 1969. 254 p, 21 fig, 71 tab, 5 append.

Descriptors: *Acid mine water, *Water costs, *Industrial water, *Appalachian Mountain Region, Economics, Water pollution effects, Acidity, Aesthetics, Color, Corrosion, Fouling, Water quality, Water chemistry.
Identifiers: Acid mine drainage costs, Industrial water costs.

Rivers and tributaries draining coal mine regions in Appalachia receive large volumes of acid mine-drainage pollution. The effects of acid mine drainage on industrial water users in Appalachia are discussed and the economic impacts on the region, should reductions in mine-drainage pollution be achieved, are estimated. Sixty-seven manufacturing plants were visited to obtain detailed data on industrial water use, water costs, adjustments to current levels of mine-drainage pollution, and potential savings from pollution reduction. Primary focus of the in-plant interviews included the food processing, paper, chemicals, textiles, primary metals, and stone and glass industries. The greatest savings to industry would be in operating costs, particularly in reduced costs of chemicals used for waste treatment. Other savings would result from reduced maintenance, less frequent replacement of equipment, and in a few cases, lower initial plant investment costs. It is concluded that reduction in mine-drainage pollution in Appalachia would have little impact on the economy of the region itself due to changes in water utilization by industry. Estimates of annual dollar savings to industry from mine-drainage reduction indicate that such savings are but an insignificant fraction of total industrial production costs or sales value. Industry production would not be altered in either volume or composition due to reductions in mine-drainage pollution. (See W70-04328). (Knapp-USGS)
W70-04329

ENGINEERING ECONOMIC STUDY OF MINE DRAINAGE CONTROL TECHNIQUES.
Rice (Cyrus Wm.) and Co., Pittsburgh, Pa.

Appalachian Regional Commission Report on Acid Mine Drainage in Appalachia, Appendix B, 1969. 281 p, 42 fig, 54 tab, 269 ref. ARC Contract No 69-12.

Descriptors: *Acid mine water, *Water pollution control, *Water pollution treatment, *Appalachian Mountain Region, Water costs, Water treatment, Waste water treatment, Acidic water, Iron, Sulfates, Neutralization, Reverse osmosis, Injection wells, Waste water disposal.
Identifiers: Acid mine drainage.

A series of cost curve graphs were developed to serve as a method for determining the costs of applying various techniques of controlling acid mine drainage pollution. Wherever possible, curves have been presented for changes in capital, operating, and maintenance costs where these are dependent upon the scale of application under the varying sets of general conditions characteristic of mine drainage polluted areas in the Appalachian Region. The effectiveness of each of the control techniques was studied in terms of the degree to which mine drainage pollution is controlled, and the quality characteristics of the post-technique water. The techniques in the proposed or experimental stage that offer the greatest promise and thus warrant further research and development are recommended. The recommended techniques are neutralization, reverse osmosis, streamflow regulation, deep well disposal, land reclamation, revegetation, pumping and drainage, water diversion, mine sealing, refuse treatment, and impoundment of acid water. (See W70-04328). (Knapp-USGS)
W70-04330

THE INCIDENCE AND FORMATION OF MINE DRAINAGE POLLUTION IN APPALACHIA.
Corps of Engineers, Cincinnati, Ohio. Office of Appalachian Studies; and Bureau of Mines, Pittsburgh, Pa.

Appalachian Regional Commission Report on Acid Mine Drainage in Appalachia, Appendix C, 1969. 360 p, 77 fig, 2 plate, 50 tab, 306 ref.

Descriptors: *Acid mine water, *Water pollution sources, *Appalachian Mountain Region, *Water chemistry, Acidic water, Chemical reactions, Water pollution treatment, Water quality, Multiple-purpose projects.
Identifiers: Acid mine drainage control.

Mine drainage pollution in Appalachia is generally coincidental with regions that have been or are presently being mined. The worst offending areas are in the old coal fields of West Virginia and Pennsylvania, and in a few areas of southeastern Ohio which have been stripped in recent decades. It appears that the annual acidity load has remained rather stable during the last two decades. However, the rapidly growing U.S. economy requires ever increasing amounts of energy and, at least for the next few decades, coal will provide a large percentage of the needed fuel input. Appalachian states will provide most of the coal. Without effective preventive measures, the detrimental impact of mine drainage effluent on the region's water quality will be much greater in future years. Mine drainage is a solution of mixed salts, predominately sulfates, usually containing silica and sometimes highly charged with dissolved carbon dioxide. Hydrolysis of the dissolved materials in mine drainage in streams forms acid, causing a drop in the stream's pH level. A mine drainage pollution control program should be included in a project whenever the potential benefits are seriously inhibited without abatement. (See W70-04328). (Knapp-USGS)
W70-04331

THE IMPACTS OF MINE DRAINAGE POLLUTION ON LOCATION DECISIONS OF MANUFACTURING INDUSTRY IN APPALACHIA.
Fanus Co., Inc., New York.

Appalachian Regional Commission Report on Acid Mine Drainage in Appalachia, Appendix D, 1969. 317 p, append. ARC Contract No 68-50.

Descriptors: *Acid mine water, *Economics, *Water quality, *Industrial water, *Appalachian Mountain Region, Water costs, Water treatment, Water pollution treatment, Water quality control.
Identifiers: Acid mine drainage costs.

The effect of mine drainage pollution on past decisions by industrial firms to locate (or not to locate) within the Appalachian Region is discussed. Twenty case histories of plant location searches by industries that are larger-than-average users of water are compiled. Markets were an important contributory factor which eliminated Appalachia in nine of the final location decisions. Most of the industries found that abatement of acid mine pollution would have to be 90% or better to influence decisions to locate. Unfavorable location decisions are caused by poor water quality in the textile dyeing, paper, chemical, plastic, and aluminum industries. In many others, acid mine drainage pollution is not an important plant location factor. (See W70-04328). (Knapp-USGS)
W70-04332

IMPACT OF MINE DRAINAGE ON RECREATION AND STREAM ECOLOGY: APPENDIX E. MINE DRAINAGE POLLUTION AND RECREATION IN APPALACHIA.
Nathan (Robert R.) Associates, Inc., Washington, D.C.

Appalachian Regional Commission Report on Acid Mine Drainage in Appalachia, Appendix E, 1969. 114 p, 28 tab, 63 ref, 5 append.

Descriptors: *Acid mine water, *Water pollution effects, *Recreation, *Water costs, *Appalachian Mountain Region, Economics, Water pollution treatment.
Identifiers: Acid mine drainage costs.

Among the detrimental aspects of mine acid drainage is the impairment of outdoor water-based recreational activity. Mine acid pollution can inhibit and may even completely deter the use of natural waters for swimming, water-skiing, or skin-diving, and for both warm and cold water sport fishing. A study was made to estimate the magnitude of the activity loss and the resultant economic (monetary) loss which could result from a failure to abate the mine acid drainage in the polluted areas of Appalachia containing potentially recreational waters. If changes are made in water quality by various degrees of mine acid reduction, a region may be able to realize some or all of the income from the otherwise lost potential recreation expenditure. To the extent that mine acid waste abatement makes it possible to realize the increases in expenditures, these may be viewed as a schedule of opportunity benefits to which the regional income multipliers can be applied. (See W70-04333). (Knapp-USGS)
W70-04333

DELAWARE RIVER BASIN COMPACT (WATER SUPPLY, POLLUTION CONTROL, FLOOD PROTECTION).
For primary bibliographic entry see Field 06B.
W70-04359

BIODEGRADABILITY OF POTENTIAL ORGANIC SUBSTITUTES FOR PHOSPHATES,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Cincinnati Water Research Lab.
Robert L. Bunch, and M. B. Ettinger.
Proceedings 22nd Industrial Waste Conference, Lafayette, Indiana, p 393-396, 1967. 1 fig, 14 ref.

Descriptors: *Water quality, *Eutrophication, *Detergents, *Phosphates, Chelation, Waste treatment, Aquatic algae, Aquatic plants, Testing, Biodegradation.
Identifiers: *Complexones, *Algal blooms, NTA, EDTA, HEIDA, Lake Tahoe (Calif).

The undesirable eutrophication of waters may be considerably reduced by replacing phosphates in industrial processes and detergents with biodegradable chelating agents, such as nitriloacetic acid (NTA) and hydroxyethyliminodiacetic acid (HEIDA). The use of detergents containing non-phosphate builders is suggested, especially for extreme situations, such as Lake Tahoe. The use of non-biodegradable agents which complex heavy metals will depend upon their effect on waste treatments, softening water, drinking water, and calcium metabolism of man. (Wilde-Wisconsin)
W70-04373

BRIEF TO THE INTERNATIONAL JOINT COMMISSION CONCERNING THE POLLUTION OF LAKES ERIE, ONTARIO AND THE INTERNATIONAL WATERS OF THE ST LAWRENCE RIVER,
Toronto Univ. (Ontario). Great Lakes Inst.
P. H. Jones.
University of Toronto, February 6, 1970. 12 p, 3 fig.

Descriptors: *Lake Ontario, *Lake Erie, *Great Lakes, Detergents, Phosphate, Testing.
Identifiers: St Lawrence River, Heavy duty detergent, Detergent biodegradability tests, Fish toxicity studies, Algae studies, Biodegradable detergent.

Phosphate is the critical nutrient in the fertilization of the Great Lakes, and detergents contribute 1/2 to 2/3 of the phosphates reaching waste treatment plants. A non-phosphate heavy duty laundry detergent has been developed which is comparable in cleaning effectiveness with current products, and would cost no more to produce when economies of scale are achieved. It contains nothing which would upset the natural cycle or create pollution conditions. Biodegradability studies resulted favorably. Other tests are under way. (Powers-Wisconsin)
W70-04378

A RIVER DIES--AND IS BORN AGAIN,
Fred J. Cook.
In: Controlling Pollution, ed. Marshall I. Goldman, Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1967, p. 130-138, and New York Times Magazine, April 13, 1965.

Descriptors: *Water pollution, *Financing, *Legal aspects, *Coordination, *Sewage districts, *Sewers, *Sewage treatment, *Sewage, Estuaries, Decision making, Public health, Industrial wastes, Population, Municipal wastes, Fish, Oxygen demand.
Identifiers: *Raritan River, *Middlesex County Sewage Authority, *New Jersey State Health Department, Trunk sewer, Public relations, Compliance powers.

The Raritan River became highly polluted by World War I and was 'dead' by 1928. Under the 'New Deal' sewerage treatment plants were built to rectify this situation. A centralized system was suggested, but separate municipal plants were constructed. By 1940 these plants were obsolete. The industrial and population growth brought on by World War II were phenomenal. By 1950 the river was a controversy again. The Middlesex County Sewage Authority (MCSA) was established by the County. The MCSA had no compliance powers and cooperation was piecemeal. Weakened, the MCSA worked to gain public support. Since communities had built treatment plants only ten to fifteen years earlier, they would be reimbursed for their plant's present value when they joined the MCSA's trunk sewer and treatment system. Within six months the river began to come alive again. Although much improved, the Raritan was a disappointment. Non-MCSA municipalities and industries are to blame. Court action is planned, but will be useless unless the State Health Department is funded sufficiently to prepare a viable case. Public pressure will be necessary for this to occur. (Richmond-Chicago)
W70-04428

EFFLUENTS AND AFFLUENCE,
New England Interstate Water Pollution Control Compact.
Jared E. Hazelton.
In: Controlling Pollution: The Economics of a Cleaner America, ed. Marshall I. Goldman, Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1967, p. 91-98, and New England Business Review, June 1965, pp. 2-9.

Descriptors: *New England Interstate WPS Compact, *Interstate compacts, *Sewage treatment, *Water zoning, *Coordination, *Classification, Water supply, Water demand, Planning, Costs, Benefits, Aesthetics, Public health, Federal government, State governments, Local governments, Flood plains.
Identifiers: *Interstate pollution, *Interstate cooperation, *Federal Water Pollution Control Act, *Restrictions, Comprehensive planning.

The river zoning approach used by the New England Interstate Water Pollution Control Compact is described. The responsibility for polluting activities is placed on both municipalities and industries. Various approaches to cleaning up the waterways are discussed: setting minimum standards; building treatment plants; and zoning. The conclusion is that it is best to make decisions on the basis of balancing costs of treatment against the benefits which various water uses bring to the community. However, minimum standards are always invoked to insure public health and aesthetic qualities. The growth of the federal role in water pollution abatement and similar state activities at the state level are discussed in light of the Federal Water Pollution Act of 1956. This legislation is reviewed in terms of its enforcement and financial assistance powers. Finally, concern is voiced that unless comprehensive interstate planning is carried out, the result of water pollution abatement and flood control programs might be the encroachment onto flood plain areas which would better serve as open space. (Richmond-Chicago)
W70-04429

THE GREAT AND DIRTY LAKES,
Gladwin Hill.
In: Controlling Pollution: The Economics of a Cleaner America, ed. Marshall I. Goldman, Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1967, p. 43-48, and Saturday Reivew, Oct. 23, 1965.

Descriptors: *Algae, *Industrial wastes, *Municipal wastes, *Great Lakes, *Water pollution, Sewage, Aesthetics, Aerobic conditions, Anaerobic conditions, Water supply.
Identifiers: *Devolution, *Interstate pollution, *Metropolitan areas, Blondin.

The pollution of the Great Lakes is discussed. Focusing on Niagra Falls, the sources of pollution from Duluth to Buffalo are traced. Special attention is given to the Chicago and Detroit metropolitan areas. The Great Lakes are treated as one continuous system and suggests interstate pollution abatement as the only possible recourse, rejecting international efforts as cumbersome and intrastate efforts as ineffectual. While recognizing the municipal waste as a major pollution source, the author concentrates on industrial wastes from the oil, steel, paper, soap, chemical and automotive industries. He cites the Chicago and Detroit metropolitan areas as the main dischargers of ammonia nitrogen, phenols, cyanide, oil, phosphates, chlorides, suspended and settleable solids and nitrogen compound wastes into the Lakes. Chicago's efforts to maintain a usable water supply and Detroit's outdated sewage treatment facilities are also reviewed. The death of Lake Erie is treated along with a discussion of the devolution of aquatic life which accompanied it. The efforts of private individuals and conservation groups and those of various state and federal governments are treated. (Richmond-Chicago)
W70-04430

THE REBIRTH OF A RIVER,
Lee Edson.
In: Controlling Pollution, ed. Marshall I. Goldman, Englewood Cliffs, N.J., Prentice-Hall, Inc., 1967, p. 143-149, and Petroleum Today, Summer, 1966.

Descriptors: *Ohio River, *River basin commissions, *Municipal wastes, *Financing, *Sewage treatment, *Standards, *Local governments, *Water pollution, *Water quality control, State governments, Fishkill, Public health, Monitoring, Coordination, Thermal pollution, Sewage, Oil industry, Coal mine wastes, Chemical wastes.
Identifiers: *ORSANCO, Spills, Paper industry, Metal finishing industry, Steel industry.

Industry's willingness is illustrated to take part in cooperative efforts to develop and then comply with minimum water quality standards. The importance is noted of public support, quoting Abraham Lincoln: 'Public sentiment is everything. With public sentiment nothing can fail; without it nothing can succeed.' ORSANCO's (Ohio River Valley Water Sanitation Commission) history is traced from its conception in 1935, through its inception in 1948, to its success as of 1967. Since 1948, over $1 billion has been spent to treat 99.4 per cent of the effluent discharged into the river. Ninety per cent of these funds came from local, state and industrial coffers; the federal government not being needed to solve local problems. However, the U.S. Army Corps of Engineers, the Public Health Service, the U.S.G.S. and the U.S. Weather Bureau have all contributed to the maintenance of ORSANCO's monitoring efforts. While the job is not complete, the 'oil, chemical, coal, paper, metal finishing and steel companies' have made a major contribution in the ORSANCO success story. Thermal pollution from nuclear plants is seen as a significant threat to the environment. Pleasure craft operators and nuclear plants are blamed for most of the remaining water pollution. (Richmond-Chicago)
W70-04436

THE CHICAGO SEWER SYSTEM, 100 YEARS OF PROTECTING CHICAGO'S HEALTH,
Department of Water and Sewers, Chicago, Ill.
For primary bibliographic entry see Field 08A.
W70-04438

AMINO ACID CHELATING AGENTS IN DETERGENT APPLICATIONS,
Grace (W. R.) and Co., Nashua, N.H. Hampshire Chemical Div.
Robert R. Pollard.
Soap and Chemical Specialties, Vol 42, No 9, p 58-62, 130-135, 1966. 11 fig, 2 ref.

Descriptors: *Detergents, *Soaps, *Chelation, Pollution abatement, Toxicity, Biochemical oxygen demand, Biodegradation, Phenols, Sewage treatment.
Identifiers: *Polyphosphates, Polymeric phosphates, Sodium LAS, NTA, EDTA, Chelating agents.

Toxicological studies, including rats, rabbits, and fish, as test organisms, suggested that nitrilotriacetic acid (NTA), or its trisodium salt NTATS, can advantageously replace some polyphosphates (STPP, TSPP, TKPP) in soaps and detergents. The NTATS is an alkaline material hydrolyzing in water into a weak acid and a strong base, and, in turn, possessing considerable buffering capacity. The salt does not appear to exhibit significant biochemical oxygen demand over periods up to 31 days or inhibit biodegradation of linear alkylsulphonates (LAS) and phenol biooxidation at levels of about 100 ppm. The salt does not influence factors of sewage treatment. The optimum concentration of NTA, combination of NTA with polyphosphates, effect of water hardness, the effectiveness of NTA as a builder of amino oxides and alkyl phosphonic diamides are among several aspects awaiting investigation. (Wilde-Wisconsin)
W70-04456

THE ROLE OF CULTURED POND FISH IN THE CONTROL OF EUTROPHICATION IN LAKES AND DAMS,
Fish Culture Research Training Inst., Malacca (Malaysia).
For primary bibliographic entry see Field 05C.
W70-04467

NATURAL RESOURCE PROTECTION THROUGH SHORELAND REGULATION: WISCONSIN,
Wisconsin Univ., Madison. Dept. of Agricultural Economics.
Douglas A. Yanggen, and Jon A. Kusler.
Land Economics, Vol 44, p 73-86, February 1968. 2 fig, 41 ref.

Descriptors: *Shore protection, *Regulation, *Zoning, Wisconsin, Lakes, Water pollution control, Water resources development.
Identifiers: *Shorelands, University of Wisconsin, County zoning, State zoning.

In August 1966 the State of Wisconsin enacted a law to minimize water pollution and to preserve fish, wildlife, and natural beauty. It prescribes county zoning of the unincorporated shorelands of all navigable waters, with the provision of state level zoning where counties fail to act by January 1, 1968. Shorelands are defined as 1000 feet from lakes and 300 feet from rivers. Small lot sizes and individual septic tanks have led to pollution of wells and surface waters, and overcrowding of the shores destroys scenic beauty. The definition of 'zoning' may include the regulation of water supply, waste disposal, tree-cutting, structure setback from highways and navigable water, filling and grading, and subdivisions; but the interpretation must not lead to the unconstitutional confiscation of private property. A group from the Wisconsin Division of Resource Development and the University of Wisconsin prepared a model shoreland protection approach which attempts to meet the statutory objectives with minimum delay by establishing a development code and a simple districting scheme for the shoreland areas. (Powers-Wisconsin)
W70-04493

SPECIFIC PROBLEMS IN RIVERS: ALGAE IN RIVERS OF THE UNITED STATES,
Public Health Service, Cincinnati, Ohio Div of Water Supply and Pollution Control.
C. Mervin Palmer.
Transactions of the seminar on Algae and Metropolitan Wastes, held at Cincinnati, Ohio, April 27-29, 1960, sponsored by Division of Water Supply and Pollution Control and the Robert A Taft Sanitary Engineering Center. Algae and Metropolitan Wastes, U S Department of Health, Education, and Welfare, Division of Water Supply and Pollution Control; and Robert A Taft Sanitary Engineering Center, Cincinnati, Ohio, Technical Report, SEC TR W61-3, p 34-38, 1961. 3 fig, 4 ref.

Descriptors: *Rivers, *Algae, *Sampling, *Mississippi River, *Ohio River, Nuisance algae, Water quality, Sewage effluents, Diatoms, Missouri River, Columbia River, Colorado River, Tennessee River, Hudson River, Delaware River, Water pollution effects.
Identifiers: *River studies, *National Water Quality Network, Algae counts, Plankton analyses, Agricultural runoff, Arkansas River, Merrimack River, Red River, Savannah River, Snake River, Rio Grande River, Potomac River.

Investigation of algae in rivers of the United States have been lacking due to the general impression that they are relatively scarce. However, more data is needed to determine their significance as pollution indicators, stream purifiers, nuisance growths, and food for fish. Basic information should be collected for extended time periods during each month of the year for as many rivers in representative locations as possible. Such data should yield necessary background information for studies and aid in determining effects of particular factors on river biota. Since 1957, the National Water Quality Network program of the Public Health Service has carried on such sampling program for 16 rivers and the Great Lakes. For the first two years the average count per monthly samples was 3,625 algae/milliliter, lowest counts occurring in November, December, and March, highest in April, September, and October. Highest plankton counts occurred in rivers enriched by agricultural runoff and sewage effluents, particularly where toxic industrial wastes were lacking. The same few genera of algae are found to dominate rivers across the country. Two comparison studies at the Robert A Taft Sanitary Engineering Center deal with green algae of the Mississippi and Ohio Rivers and number of genera of diatoms in several river systems. (See W70-04506). (Ketelle-Wisconsin)
W70-04507

ECONOMICS AND POLITICS INFLUENCE POLLUTION ABATEMENT RESEARCH,
Dow Chemical Co., Midland, Mich.
J. B. Hemwall.
Water and Sewage Works, Vol 116, No 6, p 222-225, June 1969. 4 p.

Descriptors: *Economics, *Political aspects, *Water pollution, *Pollution abatement, Value, Costs, Prices, Water treatment, Taxes, Waste disposal, Water pollution control.
Identifiers: Subsidy, Penalties, Social base, Fluid-fluid separation, Solid-fluid separation.

Meeting the research needs in pollution abatement, while necessary, is far from sufficient to get anything accomplished. The literature contains references to unmet research needs and additional information is available from the Federal Water Pollution Control Administration. This discussion, however, is addressed mainly to the influences which make pollution abatement research insufficient--namely, economics, politics and social habits. The author states that the outstanding economic characteristic of water is that it has no value. Its price is quite arbitrary and there is a great deal of federal activity that can be considered a subsidy. The economics of water is even worse after the water has been used. Initially, payment has to be made for the cost of transportation, for whatever treatment is performed, and for the

operation of the system. These items establish a cost, if not a value. Used water has neither value nor cost and there is no economic incentive to clean it up. Suggestions are offered that could improve the economics of water in this area. Other problems of water pollution abatement in the areas of politics and unmet needs are discussed. (Loeb-Rutgers)
W70-04518

WATERCRAFT REGULATION.

Mo Ann Stat secs 306.010 thru 306.310 (1963), as amended, (Supp 1970).

Descriptors: *Missouri, *Boats, *Boating regulations, Legislation, Boating, Water sports, Recreation, Administration, Governments, Legal aspects, Water law, Permits, Wastes, Sewage, Water pollution.
Identifiers: Water toilets.

Every motorboat operated in this state shall be numbered. Issuance and display of registration numbers is regulated. A change in ownership of a motorboat requires issuance of a new registration number. Motorboats registered under a federal number system or a federally approved state system are not required to register, nor are vessels owned by the United States or ships' lifeboats. Motorboats are divided into four classes according to length for purposes of equipment and lighting requirements prescribed by statute. Reckless or drunken operation of motorboats is prohibited. Motorboat regattas and towing of waterskiers are regulated. Operators involved in motorboat accidents are required to aid accident victims. If an accident results in death or property damage greater than $100 the operator must file a report with the Boat Commission created by statute. Boat livery is regulated. Funds collected from motorboat registration shall be used to promote safe boating. Each violation under this chapter is punishable by fine or imprisonment. Marine toilets shall not discharge inadequately treated sewage. All boats are subject to inspection by the Water Pollution Board. No person shall tamper with a boat without the owner's permission. (Dye-Florida)
W70-04535

GENERAL SEWER SYSTEMS FOR FOURTH CLASS CITIES.

Mo Ann Stat secs 88.717 thru 88.740 (1952).

Descriptors: *Missouri, *Sewers, *Sewage disposal, *Local governments, Domestic wastes, Municipal wastes, Sanitary engineering, Sewage districts, Wastes, Waste water disposal, Waste disposal, Cities, Taxes, Financing, Legislation, Legal aspects.

The board of aldermen of a fourth class city may establish a system of public, district, and private sewers, paid for by taxes on all taxable property within the city. District sewers shall be established in districts prescribed by ordinance on petition by a majority of resident landowners within the district or when the board deems such establishment necessary. Taxes shall be levied throughout the district in proportion to the size of each tract taxed. Taxes may be paid in installments. Private sewers are constructed at private expense and regulated by ordinance. Private sewers may be incorporated into the public or district sewer system. The owners of appropriated private sewers shall be compensated. Owners of private sewers dissatisfied with the compensation awarded by the city may petition the circuit court for another appraisal. When the board deems necessary two or more sewer districts may be united into a joint district. The city assumes no liability for construction of private sewers unless the city owns property to be served by the sewer. (Dye-Florida)
W70-04536

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

STOCHASTIC ANALYSIS OF HYDROLOGIC SYSTEMS,
Illinois Univ., Urbana. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-04072

POTOMAC ESTUARY MATHEMATICAL MODEL,
Federal Water Pollution Control Administration, Annapolis, Md. Chesapeake Field Station.
For primary bibliographic entry see Field 05B.
W70-04077

SIMULATION OF DAILY STREAMFLOW,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
For primary bibliographic entry see Field 02E.
W70-04130

SOME CONSIDERATIONS IN THE ADAPTION OF MARKOV PROCESS THEORY TO RAINFALL-RUNOFF PHENOMENON,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 02A.
W70-04254

A STATISTICAL METHOD TO SEARCH FOR A RAINFALL-RUNOFF RELATIONSHIP,
Universidad Nacional Autonoma de Mexico, Mexico City. Instituto de Ingenieria.
For primary bibliographic entry see Field 02A.
W70-04256

ANALYSIS OF 'BLACK BOX' RELATIONSHIP BETWEEN RAINFALL AND RUNOFF,
Pittsburgh Univ., Pa. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-04257

TRANSFORMATION OF DETERMINISTIC AND STOCHASTIC PROCESSES IN HYDROLOGY,
Arizona Univ., Tucson.
For primary bibliographic entry see Field 02A.
W70-04258

A CASE FOR THE SIMULTANEOUS APPLICATION OF DETERMINISTIC AND STOCHASTIC METHODS IN HYDROLOGY,
Manchester Coll. of Science and Technology (England).
For primary bibliographic entry see Field 04A.
W70-04259

COMPUTER MODEL OF CONNECTICUT RIVER POLLUTION,
United Aircraft Corp., East Hartford, Conn. Research Labs.
For primary bibliographic entry see Field 05B.
W70-04302

MATHEMATICAL SIMULATIONS FOR BETTER AQUIFER MANAGEMENT,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
M. W. Bittinger, H. R. Duke, and R. A. Longenbaugh.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 509-519, 1967. 11 p, 4 fig, 13 ref.

Descriptors: *Mathematical models, *Simulation analysis, *Aquifers, *Water management (Applied), Optimization, Groundwater, Computers, Economics, Optimum development plans, Systems analysis.
Identifiers: *Aquifer management.

Manipulation of groundwater storage in conjunction with surface water supplies often requires simultaneous consideration of varied aquifer hydraulic and geometric characteristics, highly variable pumping patterns in time and space, imperfectly connected bodies of surface water, and nondeterministic natural recharge. Legal, economic, and social conditions impose constraints which must be considered in aquifer operation and management. Mathematical modeling and computer analysis techniques allow consideration of these varied and changing factors. Applications to specific aquifer management problems are discussed. (Knapp-USGS)
W70-04364

DIGITAL COMPUTER SIMULATION OF ECOLOGICAL SYSTEMS,
Pennsylvania Univ., Philadelphia. Johnson Research Foundation.
David Garfinkel.
Nature, Vol 194, No 4831, p 856-857, 1962. 5 fig, 1 tab, 10 ref.

Descriptors: *Digital computers, *Simulation analysis, *Systems analysis, *Ecosystems, Analytical techniques, Planning, Food chains, Predation, Grazing, Computer programs, Computer models.
Identifiers: Ecological efficiency, Population dynamics, UNIVAC I, Mass action law, Theoretical ecology, Competitive exclusion principle.

Certain ecological processes are analogous to chemical reactions, describable by the mass action law of chemistry; such similarities permit derivation of methods approximating ecosystems of varying complexity. By representing ecological interactions as chemical reactions, program--devised for UNIVAC I--enables digital computer to write instructions automatically and solve an associated set of differential equations, by numerical methods when presented with a set of initial conditions. Behavior of a theoretical ecosystem is examined where grass is grazed by rabbits, which may be adequately fed or starved, with assumption that starved rabbits die, whereas fed rabbits reproduce. Grass is considered partially unavailable to guarantee its constant influx to system. System is simulated by nine equations, each with a rate constant, and three resultant differential equations. Varying predative efficiency demonstrates ecologically identifiable situations where rabbit population becomes extinct, their numbers attain steady state with time, or are thrown into periodic or damped oscillations. Methods are advantageous because: computer deals with the mathematics; degree of complexity is limited only by speed and memory of computer. Calculations are applicable to theoretical studies or actual situations, as in pest control, but calculability cannot substitute for detailed knowledge of ecosystem involved. (Eichhorn-Wisconsin)
W70-04458

DEVELOPMENT OF A MATHEMATICAL MODEL FOR PREDICTION OF TEMPERATURE IN DEEP RESERVOIRS-PHASE II: HIGH DISCHARGE-VOLUME RATIO RESERVOIRS,
Water Resources Engineers, Inc., Lafayette, Calif.
G. T. Orlob, L. G. Selna, and D. E. Evenson.
Progress Report prepared for the Department of Fish and Game, State of California, by the Water Resources Engineers, Inc., September, 1966. 12 p, 7 fig.

Descriptors: *Mathematical Models, *Temperature, *Reservoirs, *Thermal stratification, Lakes, Diffusion, Heat transfer, Energy transfer, Digital computers, Density currents, California.

The modification of the mathematical model for computation of temperature distribution in reservoirs to make it useful for that of reservoirs which have highly variable horizontal cross-sections or which experience time varying independent inflow and outflow is discussed. The mathematical model is designed to account for net heat flow input from the atmosphere. Using this model, it would be possible to simulate a complete annual cycle of temperature change in an operating reservoir. Certain assumptions, such as the independence of heat flow and reservoir surface temperature, would continue to restrict the versatility of the model. The objective of this report is to give a detailed account of the generalizations made in the one dimensional reservoir temperature model mentioned in the Phase-I report. The model was tested using the data obtained in the Lake Tahoe studies. (See W70-04483). (Novotny-Vanderbilt)
W70-04473

PREDICTION OF THERMAL ENERGY DISTRIBUTION IN DEEP RESERVOIRS,
Water Resources Engineers, Inc., Walnut Creek, Calif.
For primary bibliographic entry see Field 02H.
W70-04476

MATHEMATICAL SIMULATION OF THERMAL STRATIFICATION IN DEEP IMPOUNDMENTS,
Water Resources Engineers, Inc., Walnut Creek, Calif.
For primary bibliographic entry see Field 02H.
W70-04481

DEVELOPMENT OF A MATHEMATICAL MODEL FOR PREDICTION OF TEMPERATURE IN DEEP RESERVOIRS PHASE I: LOW DISCHARGE VOLUME RATIO RESERVOIRS,
Water Resources Engineers, Inc., Lafayette, Calif.
G. T. Orlob, L. G. Selna, and D. E. Evenson.
Progress Report, prepared for the Department of Fish and Game, State of California, July, 1966. 38 p, 9 fig., 1 tab.

Descriptors: *Mathematical models, *Temperature, *Reservoirs, *Thermal stratification, Hypolimnion, Epilimnion, Digital computers, Diffusion, Envirnomental effects, Heat transfer, Energy transfer, Thermocline, Density currents, California.

Development of a mathematical model capable of simulating the natural annual thermal cycle in deep reservoirs is presented. Construction of this model is governed by the physical principles of water movement and energy supply and transfer. The development of the computer program is based on physical representation of a system expressed by Fick's Laws of Diffusion. The other physical principle is a consequence of the force-deformation properties of water. The eddy diffusion coefficient in the hypolimnion is assumed to be virtually constant but attains a maximum at or near the water surface and a minimum at the thermocline. The finite element technique was chosen for the solution on a digital computer. The program was written in the FORTRAN IV computer language, and description of the program and data preparation is included in the Appendix of the report. A test case is described. (See W70-04473). (Novotny-Vanderbilt)
W70-04483

A MATHEMATICAL MODEL OF STREAM TEMPERATURE,
Johns Hopkins Univ., Baltimore, Md.
For primary bibliographic entry see Field 05B.
W70-04487

THE DEMAND AND SUPPLY OF OUTDOOR RECREATION, AN ECONOMETRIC ANALYSIS,
Rutgers - The State Univ., New Brunswick, N.J.
For primary bibliographic entry see Field 06D.
W70-04511

RECREATIONAL TRIP GENERATION, A CROSS SECTION ANALYSIS OF WEEKEND PLEASURE TRIPS TO THE LAKE DISTRICT NATIONAL PARK,
Ministry of Transport, London (England).
For primary bibliographic entry see Field 06D.
W70-04512

ESTIMATION AND IDENTIFICATION OF COBB-DOUGLAS PRODUCTION FUNCTIONS,
Stanford Univ., Calif.
Marc Nerlove.
Rand McNally and Co, Chicago, 1965. 193 p.

Descriptors: *Estimating, Statistical methods, Economic efficiency, Return to scale, Time series analysis, Cross-sections.
Identifiers: *Econometrics, *Estimation, *Identification, *Cobb-Douglas production function, Inputs, Outputs, Marschak-Andrews Approach, Perfect competition, Regulated industries, Klein's approach, Reduced form estimation.

This monograph is concerned with what the economist can say about the physical relationship between the output of a specific commodity and the inputs of the factors used in the production of that commodity. An econometric investigation has its place as a first step toward a full understanding of the relation of the production function. The monograph is restricted mainly to consideration of a single industry composed of individual firms producing a uniform product and using just two factors of production, labor and capital. Complications caused by introducing additional factors of production are discussed in the empirical study presented in chapter 6. Most of the discussion assumes that the relation between the output of the product and the inputs of the factors is linear in logarithms. The Cobb-Douglas production function serves to illustrate problems in determining production functions and some general issues of estimation and identification in econometrics. Several studies are reviewed and attention is drawn to the need for relevant assumptions. Production functions, as well as other econometric methods, have been used extensively in the water area and this discussion presents a comprehensive treatment of the problems and implications of empirical estimation of production relations. (Loeb-Rutgers)
W70-04517

A THRESHOLD REGRESSION MODEL,
Ecole des Hautes Etudes Commerciales, Montreal (Quebec).
Marcel G. Dagenais.
Econometrica, Vol 37, No 2, p 193-203, April 1969, 11p, 25 ref, 4 fig.

Descriptors: *Mathematical studies, Economic evaluation, *Maximization, Time series regression, Model studies, Prices, Economic efficiency, Statistics, Regression analysis.
Identifiers: *Discontinuities, *Steplike time paths, Durable goods, Econometrics.

A special regression model is suggested to analyze economic variables possessing step-like time paths. The dependent variable is assumed not to move until the concerted action of the independent variable and the error term induces it to overcome its reaction threshold. This type of reaction can be applicable in many water resource studies where discontinuities have been observed in the production cost and demand functions. The model is presented and an application to time series data, plant size increases and cross section problems is demonstrated. The article concludes with an explanation of some of the computational problems and the derivation of the likelihood function of the model. (Murphy-Rutgers)
W70-04521

COMPUTATION OF ZELLNER-THEIL'S THREE STAGE LEAST SQUARES ESTIMATES,
Yale Univ , New Haven, Conn.
R. Narayanan.
Econometrica, Vol 37, No 2, p 298-306, April 1969. 9p, 5 ref.

Descriptors: *Economics, *Statistics, *Estimation, Mathematical studies, Model studies, Maximization, Least squares method, Economic evaluation
Identifiers *Econometrics, *Three stage least squares, *Identification.

The estimates of the parameters in the group of over-identified equations of a simultaneous equation system are unaffected if the three stage method is applied to this system. This adds to the conclusion reached by others that the large sample efficiency of the estimates is unaffected. This result is established for the general case of a simultaneous equation system subject to linear homogeneous a priori restrictions, whereas many other known properties of the three stage least squares method have been demonstrated only for the special case of simple restrictions on the structural coefficients. The potential use of three stage least squares estimation methods in model formulation and estimation of water resource systems makes this article useful to the water researcher. (Murphy-Rutgers)
W70-04523

ALTERNATIVE APPROACHES TO THE PRODUCTION PROGRAMMING PROBLEM,
Brown Univ., Providence, R.I.
M. J. Beckmann.
Engineering Economist, Vol 13, No 3, p 173-186, Spring 1968. 14pp, 5 tab, 7 ref.

Descriptors: *Linear programming, *Optimization, Economic efficiency, Computers, Marginal cost, Prices, Input-output analysis, Rivers, Canals, Agriculture, Cities, Transportation, Profits.
Identifiers: *Production programming, *Decision making, *Control variables, *Constraints, *Elimination principle, *Substitution method, *Valuation method.

A theory of production is treated in terms of relevant decision variables, rather than inputs and outputs. Linear programming and more general mathematical programming is used to analyze production in terms of control variables. Minimum cost and optimal utilization of inputs are aims of this method. In the example used, all profits are imputed to the single scarce factor. Linear programming is adapted to analysis of the compliated relationships that characterize modern decision-making problems. In the calculations, the constraints are in equation form rather than inequality form for ease of computation, although additional variables must then be introduced. The elimination principle, the substitution method, and the valuation method are all explained as various approaches to production programming. The variety of methods given and the precision offered in these methods of evaluating production phenomena make this article useful to decision-makers in the water resource field. (Murphy-Rutgers)
W70-04529

6B. Evaluation Process

ECONOMICS AND ADMINISTRATION OF WATER RESOURCES,
Colorado State Univ., Fort Collins. Natural Resources Center.
K. C. Nobe.
Available from the Clearinghouse as PB-189 771, $3.00 in paper copy, $0.65 in microfiche. Colorado State Univ, Natural Resources Center, Partial Completion Report, June 30, 1969. 12 p. OWRR Project A-005-COLO.

Descriptors: *Economic base study, *Contract evaluation, *Recreation liabilities, Regional analysis, Water resources planning, Management and

evelopment, Recreation, Legal liabilities, Liability nsurance.

rogress on three separate phases of the research roject are outlined: (1) Role of Economic Base tudy- A framework for evaluation of recent base tudies was developed. Several studies were eviewed to determine the role and delineate cases f superior analysis. Studies were ranked to deter- ine their ability to perform various functions as- ociated with water development. The major role lentified for the economic base study in water esource administration settings was to measure the ffects of water resources development on the conomic base of a region. (2) Evaluation of Spe- ial Study Contracts with State Water Board The tudy focused on an evaluation of special study ontracts entered into by the Colo. Water Conser- ation Board over a 10-year period, 1959-60 - 967-68. The evaluation included an overall analy- s of the Board's expenditures, a review of the in- ividual contracts, an analysis of the contract rocedure and an attempt to specify the nature of ublic benefits derived from these contracts. (3) ecreation Property Owner Liability - A discussion f owners' and possessors' rights, duties and liabili- es permits recognition of potential problem areas n management and permissive use by recrea- onists of private property.
W70-04053

ECONOMICS AND ADMINISTRATION OF WATER RESOURCES,
Colorado State Univ., Fort Collins. Natural Resources Center.
. Ernest Flack.
Available from the Clearinghouse as PB-189 772, 3.00 in paper copy, $0.65 in microfiche. Colorado tate Univ, Natural Resources Center, Fort Collins, Colo, Partial completion Report, June 30, 1969. 16 , 13 ref. OWRR Project A-005-COLO.

Descriptors: Cost analysis, *Water rates, Water de- nand, Federal Reclamation Law, *Low flow, Droughts, *Cities, Municipal water, Water works, Measurement (Metering).

This report presents a summary of the sub-project n Economics and Administration of Water Resources as conducted at the University of Colorado. The purposes and objectives of the esearch are outlined and abstracts, summaries and onclusions of the various sub-projects are given. A ist of reference publications is presented covering he following phases of the research: (a) Total Water Use Analysis by Cities, (b) Federal Recla- nation Law, (3) Statistical Analysis of Low Flows, nd (d) Effects of Metering on Urban Water De- nand.
W70-04054

PATTERNS OF LAND USE CHANGE AROUND A LARGE RESERVOIR,
Kentucky Water Resources Inst., Lexington.
Billy R. Prebble.
Available from the Clearinghouse as PB-189 776, 3.00 in paper copy, $0.65 in microfiche. Ken- ucky University Water Resources Institute Research Report No 22, 1969. 134 p, 2 fig, 20 tab, 3 ref. OWRR Proj No A-006-KY.

Descriptors: *Land use, *Reservoirs, *Recreation, Water resources development, Land management, Planning, Zoning, Urbanization, Economics.
Identifiers: Reservoir land use.

By examining the spatial patterns of land use hanges around a reservoir planners may anticipate windfall profits to landowners, improve environ- ental quality control, guide the land use planning f surrounding communities, and project future de- nands for increased services placed on local overnments. Several hypotheses concerning the ffects of relative location around the reservoir, the ffects of relative location, the effects of the haracteristics of an individual site, and the effects f road access are tested using analysis of variance and multiple regression. The data used for the analysis is based on Lake Cumberland, a reservoir in Southern Kentucky. (Knapp-USGS)
W70-04067

MULTIPLE PURPOSE RIVER DEVELOPMENT,
Johns Hopkins Univ., Baltimore, Md. Dept. of Sanitary Engineering and Water Resources.
Abel Wolman.
Journal American Water Works Association, Vol 62, No 2, p 71-74, Feb 1970. 4 p.

Descriptors: *Planning, *Water resources development, *Multiple-purpose projects, *Inter-basin transfers, Interstate, Legislation, Optimum development plans, Political aspects, River basin development, Social aspects, Urbanization.
Identifiers: Water resources planning.

The history of water resources research in North America is briefly reviewed. Present trends are discussed and suggestions are made for more efficient ways of utilizing river basin resources. Historically, interest in water was largely local, dominantly single-function, and most often in isolation, even where uses were regional in character. Water development in general was haphazard. Orderless, unintegrated treatment of water problems should no longer be tolerated. The maximum supply of water that can be made regularly available in each drainage area must be put to its best coordinated use. Since 1936, legislation, executive order, and public pressure all give well-supported evidence that the spectrum of multipurpose use has been widely accepted, often practiced in execution, and often operated in fact. The drainage basin, while obviously a good hydrology unit, may be of less value as an economic or social unit. In the last 30 years, planners in the United States have moved steadily from single purpose to multiuse of river systems. For hydrologic purposes the river basin provides sound underpinning. For social purposes, larger projects are often desirable, providing smaller-scale social and hydrological aspects are not overlooked or slighted. Retrospective studies (post-audits) of existing projects should be pursued to provide realistic experience to strengthen future plans. (Knapp-USGS)
W70-04079

DELAWARE RIVER BASIN COMPACT.

Pa Stat Ann tit 32, secs 815.50, 815.101 (1967).

Descriptors: *Pennsylvania, *Interstate compacts, *River basin development, *Delaware River Basin Commission, Water management (Applied), Regulation, Water allocation (Policy), Interstate rivers, Delaware River, New Jersey, Project planning, Administration, Water utilization, Flood plain zoning, Water resources development, Standards, Coordination, Water supply, Water pollution control, Flood control, Watershed management, Hydroelectric power, State governments, Financing, Legal aspects.
Identifiers: *Delaware River Basin Compact.

In order to improve the Delaware River between Philadelphia, Pennsylvania and Trenton, New Jersey, the Department of Forests and Waters is authorized to cooperate with the United States as much as possible and do all acts necessary to effectuate the purpose of improving the river area. The purposes of the Delaware River Basin Compact are to promote interstate comity; to remove causes of controversy; to secure and protect present developments within the states; to encourage and provide for the planning, conservation, and development of the basin's water resources; to provide for cooperation by the signatory parties; and to apply the principle of equal treatment to all water users and to all users of related facilities without regard to established political boundaries. This Compact has an initial duration of 100 years. Commissioners appointed by the President of the United States, and the governors of the signatory states of Delaware, New Jersey, New York, and Pennsylvania, make up the Delaware River Basin Commission. The general areas dealt with by the Compact are: water supply; pollution control; flood protection; watershed management; recreation; hydroelectric power; and regulation of withdrawals and diversions. (Dearing-Florida)
W70-04081

QUANTITATIVE COMPARISON OF SOME AESTHETIC FACTORS AMONG RIVERS,
Geological Survey, Washington, D.C.
Luna B. Leopold.
Report available at no cost from US Geological Survey, Wash, DC 20242. Geological Survey Circular 620, 1969. 16 p, 6 fig, 12 photo, 5 tab.

Descriptors: *Scenery, *Rivers, *Aesthetics, *Natural resources, *Evaluation, Cost-benefit analysis, Parks, Recreation, Conservation, Scenic easements, Wild rivers, Geomorphology.
Identifiers: Quantitative scenery-evaluation.

A preliminary attempt was made to quantify some elements of aesthetic appeal while eliminating, insofar as possible, value judgments or personal preferences. If methods of recording such factors can be developed, the results promise to be a useful, new kind of basic data needed in many planning and decision-making circumstances. Such data would be especially useful when choices must be made among alternative courses of action. Such data would tend to provide a more prominent consideration of the nonmonetary aspects of a landscape. (Knapp-USGS)
W70-04101

POTOMAC-SHENANDOAH RIVER BASIN.
Virginia Dept. of Conservation and Economic Development, Richmond. Div. of Water Resources.

Virginia Division of Water Resources Planning Bulletins No 207-210 (4 vol), 1968. 772 p, 300 plates, 92 tab, 111 ref, 2 append.

Descriptors: *Water resources development, *Planning, *Virginia, Hydrogeology, Rivers, Economics, Water requirements, Water supply, Water quality, Streamflow, Water yield, Water management (Applied).
Identifiers: Shenandoah River, Potomac River.

The purpose of this study by the Virginia Division of Water Resources for the Board of Conservation and Economic Development is to re-examine the Potomac-Shenandoah Basin in light of its latest growth, to project the economy of the area to the year 2020, and to determine the quantitative and qualitative water needs of the area for the future as well as for the present. A firm program for development and use of the waters of the basin is also presented. The reports of the study will be contained in six volumes. Volume I is an introductory volume, Volume II is an economic base study of the basin. Volume III contains a hydrologic analysis of the basin to include a study of surface water, groundwater, and meteorology. Volume IV presents the quantitative and qualitative water resource requirements in the basin. (Knapp-USGS)
W70-04111

DELAWARE RIVER BASIN COMPACT (POWERS AND DUTIES OF THE COMMISSION).

Pa Stat Ann tit 32, sec 815.101, Art 1 thru 3 (1967).

Descriptors: *Pennsylvania, *Interstate compacts, *Delaware River Basin Commission, *River basin development, Project planning, Coordination, Administrative agencies, Legal aspects, Conservation, Water law, Federal government, Federal-state water rights conflicts, Water resources development, Equitable apportionment, Water allocation (Policy), Diversion, Prior appropriation, Adminis-

tration, Standards, Research facilities, River forecasting, Use rates, Delaware River.
Identifiers: *Delaware River Basin Compact, *Comprehensive plan.

The Commission is the develop plans and projects relating to the water resources of the Basin. The Commission has the power, in accordance with the doctrine of equitable apportionment, to allocate the Basin's waters to and among the signatory states, and to impose conditions and release requirements related thereto. The Commission is also empowered to plan, construct and operate any projects or facilities to accomplish the purposes of this Compact. It may establish standards for all projects and facilities that affect the Basin's water resources, including water and waste treatment plants, recreational facilities, trunk mains for water distribution, local flood protection works, small watershed management programs, and groundwater recharging operations. In addition, the Commission may: conduct and sponsor research on water resources; compile and coordinate systematic stream stage and groundwater level forecasting data; conduct special groundwater investigations; prepare and publish information with respect to the water problems of the Basin; negotiate for finances; and fix or alter rates for the use of facilities which it owns or operates. (Dearing-Florida)
W70-04134

ECOLOGY: ITS PLACE IN WATER MANAGEMENT.
Michigan Univ., Ann Arbor. School of Natural Resources.

Water Spectrum, Vol 1, No 1, p 10-14, Summer, 1969. 5 p.

Descriptors: *Ecology, *Environment, Natural resources, *Water management (Applied), Air pollution, *Water resources development, Public opinion, Water pollution.
Identifiers: *Water resources management.

The last few years have seen a new emphasis on ecology in the management of natural resources. While ecology does not provide a master key for resource planning and management, failure to give attention to the interrelations among living organisms and their environment in the development and use of resources has had some unfortunate consequences. Evidence is accumulating that ecological information is as important an input in almost everything we do in the resources field as are economics and engineering. Increasingly, we are finding intolerable the deterioration of air and water, the marring of landscape, and the limited use of resources that preclude other highly valued uses. People are asking what sequence of changes will our developmental actions cause, and what indirect effects will these have on our environment. Few of the conditions that we now find undesirable, even intolerable, are actually new. What has happened is that pollution, loss of natural scenery, and preemption of the use of particular resources have occurred until a threshold of public awareness has been reached. More people are now perceiving clearly the trends of environmental change, earlier unnoticed, and are bringing pressure on public agencies and private firms to mend their ways.
W70-04138

REGIONAL CONSTRUCTION REQUIREMENTS FOR WATER AND WASTEWATER FACILITIES.
Business and Defense Services Administration, Washington, D.C.
For primary bibliographic entry see Field 05F.
W70-04168

METROPOLITAN AREA DEFINITION: A REEVALUATION OF CONCEPT AND STATISTICAL PRACTICE,
Chicago Univ., Ill. Dept. of Geography.
Brian J. L. Berry.

Available from US Bureau of the Census, Wash, DC, 20233, price - $0.50. US Bureau of the Census, Working Paper 28, 1969. 45 p, 20 fig, 91 ref.

Descriptors: *Planning, Cities, Urbanization.
Identifiers: *Metropolitan water resources, *Standard Metropolitan Statistical Areas, *Functional Economic Areas, *Consolidated Urban Regions.

A fundamental problem in metropolitan water resources is the establishment of the planning area. To this end, this study of metropolitan area definition is particularly useful to the water resource planner and manager. The purpose of this study is to conduct an examination of existing principles of area classification for Standard Metropolitan Statistical Areas, and an examination of alternate criteria in order to formulate new principles of area classification. The following steps to revise metropolitan area definitional practice in 1970 were recommended: (1) county building blocks or equivalent units be retained as the basis of any area classification, in all parts of the country; (2) county-to-county commuting data be the basis of the classification of counties into functional economic areas; (3) Functional Economic Areas (FEA) be delineated around all central counties satisfying Standard Metropolitan Statistical Area (SMSA) population criteria and in addition be created for smaller regional centers of population 25,000 to 50,000 in less densely populated parts of the country; (4) where significant cross-commuting takes place, FEA's be merged by the creation of a consistent set of Consolidated Urban Regions (CUR); and (5) consideration be given, for neatness of social accounting, to allocating all unallocated counties to one of the FEA's or CUR's on the basis of additional criteria or regional interdependence. (Davis-Chicago)
W70-04171

THE ECONOMICS OF NATURAL DISASTERS: IMPLICATIONS FOR FEDERAL POLICY,
Douglas C. Dacy, and Howard Kunreuther.
The Free Press, New York, NY, 1969. 270 p, 59 tab, 15 fig, 3 append.

Descriptors: *Disasters, Earthquakes, Flooding, Tornadoes, Resource allocation, Federal policy, *Flood plain insurance, Flood damage, Institutional constraints.
Identifiers: *Disaster relief, *P.L. 875, Small Business Administration, Cost of damages, Convergence behavior.

This book consists of essentially a series of arguments for the development of a comprehensive disaster insurance system as an alternative to the present paternalistic Federal policy. The reason given for the increasing role of government in disaster relief is the absence of adequate insurance coverage to homeowners and businesses in hazard-prone areas. The economics of disaster are divided into three parts: (1) statistical evidence on the increasing cost of natural disasters; (2) empirical evidence on short-term recuperation behavior; and (3) capital and labor needs facing disaster areas. Examined also is the Federal government role in providing disaster relief to the private sector ranging from the offering of low-interest loans from the Small Business Administration (SBA) for the replacement or repairing of damaged homes and businesses to the National Flood Insurance Act of 1968. The authors contend that the passage of the Flood Insurance Act is a step in the right direction but are critical of the fact that it only applies to flood disasters. (See also W70-04173 thru W70-04181). (Starr-Chicago)
W70-04172

THE COST OF NATURAL DISASTER IN THE UNITED STATES,
Douglas C. Dacy, and Howard Kunreuther.
In: The Economics of Natural Disasters: Implications for Federal Policy, Chapter 1, p 3-30, The Free Press, New York, NY, 1969. 10 tab, 3 fig.

Descriptors: *Disasters, Earthquakes, Flooding, Tornadoes, Resource allocation, Federal policy, *Flood plain insurance, *Flood damage
Identifiers: *Disaster relief, *P.L. 875, Small Business Administration, Cost of damages, Convergence behavior.

The threat from violent acts of nature has changed within the past century from an expectation of significant loss of life to an expectation of significant loss of property. This reversal of the life-property loss relationship is a consequence of advancing civilization: (1) the fact that man has built up his physical environment at a rapid rate; and (2) advances in meteorology and communications have made it possible to give ample warning to population of imminent disasters. A figure conceded to be an understatement (since it is only an estimate and one made in 1956) is that the average damage to the United States from hurricanes, floods, tornadoes and earthquakes has exceeded $600 million annually. This figure does not include other cyclonic, non-cyclonic storms, tidal waves, fires, droughts, freezes and rainstorms. The detailed statistical work in this book covers the period from 1925-1964. Yet 1965, which is not included, was the worst year in U.S. history, from the point of natural disasters and its cost to the nation. For the purpose of determining costs of disasters by region, the United States is divided into six fairly large regions: (1) Northeast; (2) Southeast; (3) Western; (4) South Central; (5) North Central; and (6) Ohio Valley. A section on immediate postdisaster estimates indicates that actual losses usually run about one-third of the figures given in the first estimates immediately following a disaster. The effects of such overstatements are: (1) makes it appear that recovery was much faster than it actually was; and (2) makes it easier politically for the Federal government to disperse aid more generously. (See W70-04172). (Starr-Chicago)
W70-04173

RELIEF IN NATURAL DISASTERS,
Douglas C. Dacy, and Howard Kunreuther.
In: The Economics of Natural Disasters: Implications for Federal Policy. Chapter 2, p 31-57, The Free Press, New York, NY, 1969. 5 tab, 3 fig.

Descriptors: *Disasters, Earthquakes, Flooding, Tornadoes, Resource allocation, Federal policy, Flood damage, *Institutions.
Identifiers: *Disaster relief, *P.L. 875, Small Business Administration, Cost of damages, Convergence behavior.

The purpose of this chapter is to demonstrate quantitatively the extent of the socialization of disaster costs and qualitatively how the process of Federal aid is becoming institutionalized. While the cost of natural disasters has risen rapidly the amount of financial aid to disaster victims has grown even faster and reflects a new social attitude. A section of this chapter is devoted to organizations providing assistance. Until the early fifties the major disaster relief agency in the United States was the American National Red Cross. Within the past fifteen years the Federal government has assumed a leading role; some fifty Federal agencies, bureaus and offices are involved in domestic relief. Aid to both the public and private sector is provided by the Federal government. U.S. top laws also provide another source of relief to private citizens. An analysis of statistical evidence indicates that Federal participation has increased markedly during the sixties; and a review of recent legislation indicates that Federal participation is not likely to be reduced in the future. This change in the Federal government's role is attributed to and seen to be consistent with its growing concern and involvement with problems of welfare. (See W70-04172). (Starr-Chicago)
W70-04174

ECONOMIC THEORY AND NATURAL DISASTER BEHAVIOR,
Douglas C. Dacy, and Howard Kunreuther.

: The Economics of Natural Disasters: Implica-
ons for Federal Policy, Chapter 3, p 58-78, The
ee Press, New York, NY, 1969. 2 tab, 4 fig.

escriptors: *Disasters, Earthquakes, Flooding,
ornadoes, Resource allocation Federal policy,
Flood damage, Rehabilitation.
entifiers: *Disaster relief, *P.L. 875, Small Busi-
ss Administration, Cost of damages, Conver-
nce behavior.

his chapter is concerned with a theoretical analy-
s of behavior following natural disasters. It is di-
ded into two sections: (1) the economic choices
cing the community immediately following a dis-
ter; and (2) the long-term recovery phase that
turns a community to its predisaster level. The
roblems of information and communication im-
ediately after a disaster are analyzed. Since
sually only incomplete information exists, the
ecision maker is forced to make a decision
ithout really having a choice of alternatives. The
ime concern of decision makers in disaster-torn
reas is to obtain as many emergency supplies as
ossible. They cannot calculate the economics of
ortage/storage cost ratios; they must concern
emselves with supply and demand problems.
sing concepts from the decision-making process
a firm, the authors illustrate how a better priority
heme for emergency shipments could be
eveloped with improved information on damage
nd requirements. In terms of short-term recovery,
ost disaster needs can then be met more easily and
a lower cost. In terms of the most efficient long-
rm recovery, labor and outside aid in the rebuild-
g sector should be devoted to those capital goods
hose marginal productivity is highest. (See W70-
4172). (Starr-Chicago)
/70-04175

**ROBLEMS OF INFORMATION AND COMMU-
ICATION,**
Douglas C. Dacy, and Howard Kunreuther.
n: The Economics of Natural Disasters: Implica-
ons for Federal Policy. Chapter 4, p 81-101, The
ree Press, New York, NY, 1969.

Descriptors: *Disasters, Earthquakes, Flooding,
ornadoes, Resource allocation, Federal policy,
Institutions, Flood damage, Institutional con-
raints.
Identifiers: *Disaster relief, *P.L. 875, Small Busi-
ess Administration, Cost of damages, Conver-
ence behavior.

Differentiated in this chapter on organizational
ehavior in a disaster are those events which have a
arning period (e.g., hurricanes, floods), from
hose with minimal notice (e.g., tornadoes) or from
hose with none at all (e.g., earthquakes). Efficient
ction after a catastrophe is often hampered by
hat the author calls 'convergence behavior'--the
ass movement of messages, supplies and people
oward the stricken area. The effects of the uncer-
inty caused by organizational problems and con-
ergence problems in specific disasters are
nalyzed and recommendations are made for al-
eviating the problems. The analyses of specific dis-
sters and actions taken in these disasters cover:
1) Hurricane Carla, 1961; (2) Waco and San An-
clo Tornadoes, 1953; and (3) Alaska Earthquake,
964. In order to reduce the problems caused by
onvergence behavior certain suggestions are
iven: (1) the establishment of a central office
here people may register their names and
hereabouts, thereby eliminating many telephone
alls; (2) a telephone line linking the office with
ospitals to permit rapid communication of fatali-
ies and injuries; (3) establishment of a priority
ystem for incoming phone calls so that lines are
ept open for emergency groups; (4) creation of a
entral supply clearing house to handle the deluge
f clothing, food and unsolicited supplies coming
nto the disaster area; and (5) delaying public an-
ouncement of a disaster to the rest of the nation
or several hours so as to avoid convergence
roblems caused by curious outsiders. (See W70-
4172). (Starr-Chicago)
W70-04176

SHORT-RUN SUPPLY AND DEMAND PROBLEMS,
Douglas C. Dacy, and Howard Kunreuther.
In: The Economics of Natural Disasters: Implications for Federal Policy, Chapter 5, p 102-120, The Free Press, New York, NY, 1969. 5 tab.

Descriptors: *Disasters, Earthquakes, Flooding, Tornadoes, Resource allocation, Federal policy, *Flood damage.
Identifiers: *Disaster relief, *P.L. 875, Small Business Administration, Cost of damages, Convergence behavior.

This chapter deals with the short-run problems of resource allocation following a serious disaster, i.e., food and housing, with specific reference to the Anchorage, Alaska disaster and other disaster experiences. The authors contend that most problems of supply and demand are short-term in nature because of the large amount of aid coming from outside the disaster area. Also, post disaster behavior by individuals, who operate in an altruistic fashion, serves to limit the shortages and thereby tends to keep prices lower than they would be in a regular short supply and large demand market. The authors point out the advantages of stockpiling items to handle emergency problems. While housing is not an item that can be stockpiled, actual experiences indicate that most disaster victims are usually placed in homes of friends, relatives or magnanimous community individuals by the first evening after the disaster. The consequence of this fact is that rents usually do not rise after a disaster strikes an area. (See W70-04172). (Starr-Chicago)
W70-04177

PLANNING FOR RECOVERY: THE SPECIAL PROBLEM OF DAMAGE ASSESSMENT,
Douglas C. Dacy, and Howard Kunreuther.
In: The Economics of Natural Disasters: Implications for Federal Policy, Chapter 6, p 123-140, The Free Press, New York, NY, 1969. 9 tab.

Descriptors: *Disasters, Earthquakes, Flooding, Tornadoes, Resource allocation, Federal policy, *Flood damage.
Identifiers: *Disaster relief, *P.L. 875, Small Business Administration, Cost of damages, Convergence behavior.

Assessing the value of physical damage to a disaster area constitutes one of the most difficult problems for a community. Dollar value must be quoted in order to qualify as a Federal disaster area and be eligible for aid under P.L. 875. Little information is available on what cost criteria are the bases for such damage estimates. Also, the unit of analysis is a critical factor in interpreting damage reports and in understanding the meaning of the word 'disaster.' The authors distinguish between three categories of losses: (1) losses to the public sector, e.g., sewer, electricity, telephone, Federal, state and local structures and roads; (2) losses to the private sector; e.g., physical damage to homes and businesses, and indirect economic losses as a result of the curtailment of businesses or a lower level of business operations; and (3) shortfall of revenue, or the decline of state and Federal government receipts from various tax and levies. An analysis of damage estimates and expenditures following the Alaska earthquake indicates that there is a tendency to overestimate damages during the period immediately following a disaster. This pattern is consistent with what has also occurred in other disaster areas; initial figures are almost twice as high as final damage estimates. (See W70-04172). (Starr-Chicago)
W70-04178

RECONSTRUCTION AND ECONOMIC DEVELOPMENTS FOLLOWING A DISASTER,
Douglas C. Dacy, and Howard Kunreuther.
In: The Economics of Natural Disasters: Implications for Federal Policy, Chapter 8, p 152-182, The Free Press, New York, NY, 1969. 9 tab, 2 fig.

Descriptors: *Disasters, Earthquakes, Flooding, Tornadoes, Resource allocation, Federal policy, *Flood damage, Intangible benefits.
Identifiers: *Disaster relief, *P.L. 875, Small Business Administration, Cost of damages, Convergence behavior.

It is difficult to measure exactly the progress made in the recovery period after a disaster strikes a community, and this is particularly true in the private sector. Data are not available which sort out rebuilding as a result of a disaster from overall construction activity. Activity in the public sphere is more predictable since special reports are likely to exist on work performed by Federal agencies. This chapter describes the recovery progress in Skopje, Yugoslavia following the earthquake in 1963 and compares the restoration rate for public facilities there with the rate in Anchorage, Alaska. Described also are post disaster economic improvements due to technological innovations as well as social and political factors. The empirical evidence indicates that a community may benefit economically from a disaster as a result of the rapid inflow of capital for rebuilding purposes and the adoption of technological innovations to meet crisis situations. Cited also are examples of indirect benefits to regions as a result of the physical effects of the disaster: (1) a tornado in Topeka in 1966 carried out a patch almost identical to one proposed by the city for a new superhighway; and, (2) fishing after hurricane Carla was better as a result of the cleansing of the coral reefs by the surging waters. (See W70-04172). (Starr-Chicago)
W70-04179

THE COST OF FEDERAL RELIEF,
Douglas C. Dacy, and Howard Kunreuther.
In: The Economics of Natural Disasters: Implications for Federal Policy, Chapter 11, p 222-228, The Free Press, New York, NY, 1969. 3 tab.

Descriptors: *Disasters, Earthquakes, Flooding, Tornadoes, Resource allocation, Federal policy, Taxes, Compensation.
Identifiers: *Disaster relief, *P.L. 875, Small Business Administration, Cost of damages, Convergence behavior.

The cost to Federal agencies of providing technical assistance, equipment, materials and essential services to a stricken area is relatively low. The most costly type of assistance is a grant given under P.L. 875 to restore public facilities. The type of aid constitutes a transfer payment--from one group of people to another and must eventually be paid for in full out of taxes. Another kind of transfer payment is the loss in Federal revenue due to the tax write-off provisions. A third kind of transfer is that which results from low interest rate loans from the Small Business Administration. The authors assume that: (1) sixty to eighty per cent of total disaster losses pertain to private property; (2) sixty to eighty per cent of private property is not insured; and (3) the tax rate applicable on casualty write-off is between 15 and 25 per cent. On the basis of these assumptions, the authors contend that loss in Federal revenue would vary between 5.4 and 16 per cent of the total estimated disaster losses, or an average estimate of 10 to 11 per cent. The forecast of future annual Federal cost for the next decade in present disaster programs is estimated to be an average of $92 million. (See W70-04172). (Starr-Chicago)
W70-04180

THE NEED FOR COMPREHENSIVE DISASTER INSURANCE,
Douglas C. Dacy, and Howard Kunreuther.
In: The Economics of Natural Disasters: Implications for Federal Policy, Chapter 12, p 229-261, The Free Press, New York, NY, 1969. 3 tab.

Descriptors: *Disasters, Earthquakes, Flooding, Tornadoes, Resource allocation, Federal policy, Flood plain insurance, Compensation.
Identifiers: *Disaster relief, *P.L. 875, Small Business Administration, Cost of damages, Convergence behavior.

Specific criticisms are made against the equity of the current Federal system of disaster relief: (1) low-interest SBA loans or outright grants are only given to areas classified by the Federal government as a disaster area or to areas covered by special congressional legislation; (2) the Federal policy tends to reward the imprudent rather than the prudent individual; and, (3) Federal relief does nothing to discourage individuals from moving into disaster-prone regions, e.g., flood plains. An analysis of current disaster insurance policies is given which indicates the insurance industry's lack of coverage against various natural disasters. The conclusions reached about the rationale behind the insurance industry's position are: (1) companies encourage individuals to take out insurance policies if there is a small risk of large-scale damage; (2) insurance companies willingly provide coverage against a natural disaster, such as a tornado, that could potentially affect any part of the country. The relatively low premiums of many are used to pay for the high damage of a few; (3) insurance companies are concerned with their public image and, therefore, are willing to provide earthquake insurance, if requested to do so; and (4) until this year companies have opposed flood insurance because of the relative certainty of the event in particular regions and the assumption that only individuals in those hazard-prone areas would be interested, thereby causing unusually high rates for the insurance. (See W70-04172) (Starr-Chicago)
W70-04181

WISE USE OF FLOOD PLAINS.
For primary bibliographic entry see Field 04A.
W70-04213

DELAWARE RIVER BASIN COMPACT (WATER SUPPLY, POLLUTION CONTROL, FLOOD PROTECTION).

Pa Stat Ann tit 32, sec 815.101, Art 4 thru 6, (1967).

Descriptors: *Pennsylvania, *Interstate compacts, *Water pollution control, *Flood protection, River basin development, Water management (Applied), Delaware River Basin Commission, Dams, Interstate rivers, Water supply, Surface waters, Groundwater, Regulation, Reservoirs, Storage, Regulated flow, Assessments, Sanitary engineering, Coordination, Treatment facilities, Classification, Warning systems, Delaware River, Waste treatment.
Identifiers: *Delaware River Basin Compact.

The Commission is empowered to develop and implement plans and projects for the use of the Basin's water for domestic, municipal, agricultural and industrial water supply. For this purpose, the Commission may construct, acquire and operate dams, reservoirs and other facilities for utilization of water resources and regulation of the use thereof. The Commission may survey and investigate, and acquire, construct, and operate projects and facilities to control potential pollution and abate existing pollution of the Basin's water resources. The Commission may classify the waters of the Basin and establish standards for treatment of wastes. The signatory states, in order to prevent pollution, agree to enact legislation to enable the maintenance of the Basin's waters in a satisfactory condition. The Commission may also plan, construct and operate projects and facilities for flood damage reduction. The Commission is to create standards relating to the nature and extent of the uses of land in areas subject to flooding. The Commission is empowered to acquire interests in land within the area of a flood plain for the purpose of restricting its use so as to minimize the flood hazard. (Dearing-Florida)
W70-04359

DELAWARE RIVER BASIN COMPACT (WATERSHEDS, RECREATION, HYDROELECTRIC POWER, FINANCING, GENERAL PROVISIONS).

Pa Stat Ann tit 32, sec 815.101, Art 7 thru 14 (1967).

Descriptors: *Pennsylvania, *Watershed management, *Hydroelectric power, *Financing, Interstate compacts, Withdrawal, Interstate rivers, Delaware River Basin Commission, Projects, Erosion control, Runoff, Soil management, Forest management, Recreation, Wildlife management, Recreation facilities, Dams, Diversion, Administration, Transmission (Electrical), Water shortage, Permits, Regulation, Capital, Delaware River.
Identifiers: Intergovernmental relations, Comprehensive plan, Delaware River Basin Compact.

The Delaware River Basin Commission is to promote sound practices of watershed management in the Basin, including projects and facilities to retard runoff and water flow and prevent soil erosion. The Commission is to provide for the development of water related public sports and recreational facilities. The waters of the Delaware River and its tributaries may be impounded and used by or under authority of the Commission for the generation of hydroelectric power. The Commission may regulate and control withdrawals and diversions from surface and groundwaters of the Basin. Various rules are established for the purpose of avoiding conflicts of jurisdiction. The procedures and limits for capital financing are provided. The Commission is to adopt, and may review and revise, a comprehensive plan for the immediate and long-range development and use of the water resources of the Basin. The Commission shall annually adopt a water resources program based upon the comprehensive plan. The Commission has the power of condemnation to accomplish the purposes of the Compact. (Dearing-Florida)
W70-04361

RATIONAL UTILIZATION OF MEXICO'S WATER RESOURCES (IN SPANISH),
Secretaria de Recursos Hidraulicos (Mexico).
Oscar Benassini.
Comite Nacional Mexicano para el Decenio Hidrologico Internacional, Memoria 1966-1967, 1968. p 1-27, 5 fig, 7 tab.

Descriptors: *Water resources development, *Mexico, *Planning, *Water conservation, Water demand, Population, Political aspects, Social aspects, Agriculture, Industrial water, Optimum development plans, Legal aspects, Arid lands, Water pollution, Irrigation water, Municipal water, Multiple-purpose projects, Beneficial use, Surface-groundwater relationships.

The growing world-wide problems of water scarcity are discussed and applied to Mexico. While there would seem to be a sufficient supply of water, irregular seasonal and geographical distribution of rainfall refute this supposition. Baja California, the northern tier of provinces and the north-central bolson are arid regions lacking sufficient water supply. Even in areas blessed with abundance of water, concentration of population and industry are now creating scarcity and pollution. Planning is now being done to make the best possible use of all available water for each region, with emphasis upon enterprises which will least contaminate or withdraw water supplies. The Plan Hidraulico de Mexico encompasses a fundamental objective-nationwide distribution of water resources by means of dam construction and water transfer. Public dissemination of conservation information and legal restraints are also envisioned. (Moore-Arizona)
W70-04408

FLOOD PLAIN MANAGEMENT STRATEGY: AN ANALYSIS,
Chicago Univ., Ill. Center for Urban Studies.
John R. Sheafer.
Proceedings of the Fourth American Water Resources Conference, November 18-22, 1968. p. 255-262, 1 tab.

Descriptors: *Methodology, *Planning, *Management, *Flood plains.
Identifiers: *Flood plain management, Flood plain information, Product orientation, Process orientation, U.S. Army Corps of Engineers.

Flood plain management has become a generally accepted strategy for reducing flood losses and achieving a proper use of the flood plain. It is a complex strategy which is frequently oversimplified and unduly limited when discussed. Flood plain management is a multiple means, single purpose effort that is an integral part of the comprehensive planning process. Success in a flood plain management effort is related to the degree of active participation by local interest groups--financial, professional, occupants and services. These interest groups allocate the flood plain resource in response to a variety of forces--some of which encourage more intensive use of the flood plain and some which tend to inhibit use. Current governmental efforts to achieve a proper use of flood plains have been characterized by low interaction with management interests and a product (flood plain information) orientation. It is suggested that flood plain management efforts would be enhanced, if federal efforts achieved a higher degree of interaction with local interests and there was a shift from product to process orientation. (Davis - Chicago)
W70-04424

AMENITY RESOURCES FOR URBAN LIVING,
Arthur A. Atkisson, and Ira M. Robinson.
In: The Quality of the Urban Environment, ed. Harvey S. Perloff (Baltimore: Johns Hopkins Press, 1969). p. 179-201, 3 tab, 29 ref.

Descriptors: *Social values, *Environment, *Methodology, Planning, Management, Social aspects, Urban sociology, Social needs, Attitudes, Aesthetics.
Identifiers: *Amenity resources, *Public policy, Amenity response system.

The clarification of the concept of amenities and a better understanding of what might be called the amenity management process can contribute to public policy in the environmental area. It is suggested that responses to amenities make up one of the outputs derived from man's environmental system; that these outputs can be 'managed'; and that decisional criteria and management systems can be developed to accomplish this task in a rational and socially responsible manner. Amenities are finally taken to be those stimuli which lead to feelings of comfort, pleasure or joy. Utilizing this definition a simple amenity response system is described. Five major components of this system are identified: (1) the amenity stimulus generator or precipitant; (2) the respondent; (3) the amenity; (4) the amenity response; and (5) the potential disamenities. The operation of this system is investigated in discussions of amenity responses and respondents, economic and political responses to amenities; and amenities, disamenities, and their precipitants. The demand for amenities and the amenity decision system are also investigated. With regard to the use of this type of analysis for environmental planners and managers, it is concluded that given equivalence in the economic potential of resource areas competing for development, such development should occur last in that area which exhibits the greatest amenity potential and in which the projected pattern of development would most adversely affect the area's amenity potential. (See also Vol. 2, No. 24, Field 6B, W69-10206). (Davis - Chicago)
W70-04425

REVIEW AND INTERPRETATION OF EXPERIENCES IN WATER RESOURCES PLANNING,
Pennsylvania State Univ., University Park. Inst. of Public Administration.
Irving K. Fox.
In: Intergovernmental Relations in Water Resources Planning, Seminar Preparation, June 2-

, 1969, Presented by the Institute of Public Administration, Pennsylvania State University, Conducted for the Corps of Engineers, p. 05-32, 1969).

Descriptors: *Planning, *Water resources development, River basin development, Decision making, Administrative decisions, Administration.
Identifiers: *Public policy, *Water resources planning, River basin planning, Public involvement, Administrative efficiency, Value optimization.

Water resources planning is reviewed over two periods, pre-World War II and post World War II. From an examination of pre-World War II water resources a number of general observations can be drawn. First, one is struck by the dynamic nature of the task that river basin planners are expected to perform. Second, certain features of the water planning situation appear to have become well established: (1) water development will continue to include a large measure of public involvement; (2) decisions regarding water development and use will not be entirely governmental decisions; (3) providing substantial subsidies to the beneficiaries of water resources development appears to be a well-established policy; and (4) the legislative branch appears limited in its ability to represent all interests concerned with highly subsidized water development programs. Third, most of the plans for water resources development in this country have been associated with broad public policy considerations. Since World War II, water resources planning has struggled with several problems. First, there is a lack of consensus as to the objectives of river basin planning. Second, a number of federal agencies have come to have independent, major interests and responsibilities in the water resource field. Third, state and local levels of government were taking a growing interest in water development decisions. The post war approaches to water resources planning are then appraised in light of two criteria, administrative efficiency and value optimization. (Davis - Chicago)
W70-04426

ECOSYSTEM SCIENCE AS A POINT OF SYNTHESIS,
For primary bibliographic entry see Field 06G.
W70-04433

THE CHALLENGE OF GROWTH: A STUDY OF MAJOR COUNTY AND REGIONAL PARK NEEDS.
Saint Louis County Planning Commission, Mo.

St. Louis County Planning Commission, St. Louis, Mo., July 1965. 43 p, 4 tab, 5 map, 46 photo.

Descriptors: *Recreation demand, Land use, Scenic highways, Camping, Swimming.
Identifiers: *Regional parks, *Open space, *St. Louis County (Mo).

Because of the past rapid growth and urbanization of St. Louis County, decisions must be made in advance of further urban development regarding allocation of land for public parks and outdoor recreation facilities. It is estimated that the population of St. Louis County will attain a total of one million persons by 1970 and an estimated 1,175,000 persons by 1980. On the basis of these figures and on the basis of studies conducted for the county, a proposal has been made for a system of approximately 6,000 acres of major county parks and a total of at least 45,000 acres of regional parks. All of the creeks and streams are the primary drainage channels for St. Louis County and a recommendation is made to protect them from encroachment by any type of intensive development. The suggested implementation of this plan includes Federal, state and county coordination. (Starr-Chicago)
W70-04435

AN APPRAISAL OF A LAKE MICHIGAN SITE FOR CHICAGO'S THIRD AIRPORT.
Department of Public Works, Chicago, Ill.
For primary bibliographic entry see Field 04C.
W70-04439

CHAPTER 6: FUTURE STUDIES.
Department of Public Works, Chicago, Ill.
For primary bibliographic entry see Field 04C.
W70-04443

THE OPPORTUNITY COST OF DISPLACED PRIVATE SPENDING AND THE SOCIAL DISCOUNT RATE,
Grinnell Coll., Iowa.
Robert M. Haveman.
Water Resources Research, Vol 5, No 5, p 947-957, October 1969. 11 p, 6 tab, 19 ref.

Descriptors: *Investment, *Cost-benefit analysis, *Capital investment, Risks, Government, Economics, Costs, Gross National Product, Prices, Taxes, Finance, Interest rate.
Identifiers: *Opportunity costs, *Social discount rate, *Social time preference, *Empirical estimation, Shadow prices, Rate of return, Public expenditures.

This paper first presents the major contending arguments in the debate on the social discount rate concept and its empiric estimation procedure. The different concepts on this important issue are the social time preference position, the preferred opportunity cost position and the real cost of borrowed funds. The author presents his arguments for favoring the preference opportunity cost position and the ways in which this position differs from the others is described. An estimate is then made of the opportunity cost of displaced private spending using the empiric framework implicit in the preferred social discount rate concept. The implications of the social discount rate for public investment in the water resource area make this article of interest to the water resource planner. (Murphy-Rutgers)
W70-04516

FORECASTING PRODUCT CONSUMPTION WITH COMPUTERS,
Long Island Univ., Brooklyn, N.Y.; and Long Island Univ., Greenvale, N.Y. C. W. Post Coll.
Richard J. Ward.
Engineering Economist, Vol 10, No 3, p 1-22, Spring 1965. 22 p, 5 tab, 1 fig.

Descriptors: *Forecasting, *Computers, *Oil, Statistics, Statistical methods, Regression analysis, Least squares method, Energy, Economics.
Identifiers: *Product consumption, Standard error, Trend.

The analysis presents a possible approach to forecasting petroleum--and, by implication, other product consumption with the assistance of computers. As distinct from an end-use method, where elaborate efforts are made to estimate consumption on the basis of a forecast of the units which consume the product, the method developed here relies more upon statistical measures. The technique requires only rudimentary knowledge of statistical and economic relations and it is argued here that the essence of good forecasting is to keep the forecaster's philosophy, moods, normative judgments or vested interests at the barest minimum, and to allow the facts and statistical analysis to carry as much of the forecasting burden as possible. Forecasting techniques have been used extensively in the water area and this article is of general interest to water use studies. (Loeb-Rutgers)
W70-04519

THE RATE OF RETURN AND ASSESSMENT OF RISK,
California Univ., Los Angeles.
J. Morley English.
The Engineering Economist, Vol 11, No 3, p 1-12, Spring 1966. 13 p, 5 ref.

Descriptors: *Risks, *Interest rate, Investment, Costs, Economics, Mathematical studies, Profits, Capital, Management, Inflation, Growth rate.
Identifiers: *Rate of return, *Discount rate, Time scale, Utility functions, Dividends.

In conventional evaluation of investment alternatives some index of desirability must be established. Whatever this index, the basic concept requires discounting future dollars at some acceptable rate of return. Risk is often considered by an arbitrary selection of a high rate of return. The author derives a general expression for an interest rate or internal rate of return for use in evaluation of a single investment, in context with the business as a whole. This provides a rational basis for selecting a suitable rate of return for each investment project to be considered. The use of the suggested approach gives different rates of return for projects involving different risks. It shows how size of investment will affect the required rate of return and explains the time relationship to be considered. The importance of the rate of return in considering alternative water resource investments makes the article valuable to the water resource planner. (Murphy-Rutgers)
W70-04520

OPTIMAL GROWTH AND INVESTMENT ALLOCATION,
Harvard Univ., Cambridge, Mass.; and Brandeis Univ., Waltham, Mass.
Sanjit Bose.
The Review of Economic Studies, Vol 35, No 104, p 465-480, October 1968. 16 p, 3 fig, 8 ref, 2 append.

Descriptors: *Investment, Capital.
Identifiers: *Optimal growth, *Investment allocation, Capital accumulation, Infinite horizon case, Finite horizon case.

The optimal programme of capital accumulation is examined in a two sector (consumption and investment) model of growth where the margin of decision is the allocation of investment between the two sectors. This is done by assuming that capital, once installed in a sector, cannot be used in the other, or that investment is irreversible, and by abstracting from labor as a primary output. The resulting production model is well known. The main significance of the model lies in bringing out the limitations imposed upon the choice of current output composition by the inherited structure of capital. The Ramsey approach of optimal savings is adopted in this paper. The optimal growth properties for the infinite and finite horizon cases are examined and some mathematical proofs are given in the appendices. This model has potential application problems in the public good area in general and the water area in particular where investment is irreversible. (Loeb-Rutgers)
W70-04526

WATER RESOURCES DEVELOPMENT, PLANNING, ENGINEERING AND ECONOMICS,
Manitoba Univ., Winnipeg.
Edward Kuiper.
Washington, DC, Buterworth Inc, 1965. 483 p.

Descriptors: *Water resources development, *Planning, *Engineering, Economics, Hydraulics, Hydraulic structures, Flood control, Irrigation, Navigation, Water supply, Benefits, Costs, Dams, Spillways, Interest, River systems.
Identifiers: River system development, Water power, Present value, Annuities.

This book deals with the problem of developing a river system for the greatest benefit of the people that live in its drainage basin. Chapter 1 discusses the different aspects that have to be taken into consideration when planning the water resources development of a drainage basin. Chapters 2 to 5

deal with basic engineering subjects such as hydrology, hydraulics, river morphology, and hydraulic structures. Chapters 6 to 10 deal with the main components of river development: flood control, water power, irrigation, navigation, and water supply. The discussions in these five chapters center mainly around the question of how to make the best use of available water supplies; or conversely, how much water control and supply is required to obtain a certain objective. Chapter 11 pertains to the economic analysis that must be applied to alternative water development plans in order to find the one that will yield the greatest benefits. (Loeb-Rutgers)
W70-04527

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

PATTERNS OF LAND USE CHANGE AROUND A LARGE RESERVOIR,
Kentucky Water Resources Inst., Lexington.
For primary bibliographic entry see Field 06B.
W70-04067

PRELIMINARY DETERMINATIONS OF HYDROBIOLOGICAL CONDITIONS IN THE VICINITY OF THE PROPOSED JETPORT AND OTHER AIRPORTS IN SOUTH FLORIDA, JULY 1969,
Geological Survey, Tallahassee, Fla.
For primary bibliographic entry see Field 04C.
W70-04078

ECONOMIC THEORY AND NATURAL DISASTER BEHAVIOR,
For primary bibliographic entry see Field 06B.
W70-04175

PLANNING FOR RECOVERY: THE SPECIAL PROBLEM OF DAMAGE ASSESSMENT,
For primary bibliographic entry see Field 06B.
W70-04178

THE COST OF FEDERAL RELIEF,
For primary bibliographic entry see Field 06B.
W70-04180

CHAPTER 5: COST.
Department of Public Works, Chicago, Ill.
For primary bibliographic entry see Field 04C.
W70-04442

FINANCIAL MANAGEMENT OF A WATER UTILITY,
Pate, Hirn and Bogue, Inc., Detroit, Mich.
Stuart H. Bogue.
American Water Works Association Journal Vol 60, No 3, p 267-272, March 1968. 6 p.

Descriptors: *Public utility, *Planning, *Financing, *Management, Demand, Water supply, Budgeting, Government, Political aspects, Investment, Interest rate, Debt, Bonds.
Identifiers: *Program development, *Record keeping, *Special assessments.

Water utilities have inadequate funding for operating a proper system. Some water utility expenses are outlined and three examples are given of successful and unsuccessful water utility management. The means of financing are explained with the emphasis on the different types of bond financing. The successful financial management of a water utility involves proper planning, thorough record keeping and careful decisions. The necessity of running a water utility on a sound basis to meet the increasing demands of its customers is stressed throughout. (Murphy-Rutgers)
W70-04513

PUBLIC ECONOMICS,
Oslo Univ. (Norway).
Leif Johansen.
Amsterdam, North-Holland Publishing Co, Chicago, Rand McNally and Co, 1965. 367 p.

Descriptors: *Taxes, Prices, Economics, Employment, Stabilization, Profit, Credit, Debt, Interest rate, Demand, Loans, Costs, Income, Depreciation, Welfare, Investment.
Identifiers: *Public finance, *Targets, *Instruments, *Macroeconomics, *Fiscal policy, *Public debt, *State budget, *State accounts, *Collective consumption, Public sector, Economic theory, Preference function, Private consumption, Collective wants, Economic growth, Income distribution, Price level.

The book treats economic theory in its relation to the problems of public economy and lays emphasis on principles and applications of theory rather than on description. As such, a complete description of national institutions, fiscal system and policy, and any systematic comparison between countries has been avoided. Facts and figures from Norway and other countries are used mainly to clarify points of principle, and to illustrate the practical importance of the problems which are treated. Simple economic models are employed in the book. A prior knowledge of some basic macro-economic theory and economic welfare theory is recommended. References to literature are given. The theoretical economic problems of water resources are contained in the public finance area and this book will be of aid to the researcher concerned with the underlying economic theory of public goods and public finance. (Loeb-Rutgers)
W70-04514

THE EFFECT OF FINANCIAL INDUCEMENTS ON THE LOCATION OF FIRMS,
Kentucky Univ., Lexington; and Rutgers - The State Univ., New Brunswick, N.J.
William J. Stober, and Laurence H. Falk.
Southern Economic Journal, Vol 36, No 1, p 25-35, July 1969. 11 p, 3 tab.

Descriptors: *Sites, Investment, Model studies, Costs, Taxes, Income, Interest rate, Capital, Labor.
Identifiers: *Financial inducement, *Analytical model, Investment decision, Lease payment, Least cost.

Despite the proliferation of state and local inducements to industrial development, little has been written on their observable or potential influence on location decisions. Generalizations regarding the importance of many other factors controlling the choice of location and analysis of replies to questionnaires submitted to inducement recipients dominate discussions of this matter and point to the uninformative and questionable conclusion that financial inducements are at best a marginal factor in the selection of a location. However, such variables as the growth in the size of firms receiving inducements suggest that financial inducements may indeed be an effective means of attracting industry. The purpose of this paper is to employ an analytical model to isolate the variables that determine the effectiveness of financial inducements. To this end, the investment decision and its relevance to locational choice is examined. Financial inducements are also incorporated into the model and their effect on relative costs determined. Finally, the model is more completely specified and numerical results are presented for representative cases. This paper has potential interest in the water area with respect to attracting water using industries and to assisting water supply developments. (Loeb-Rutgers)
W70-04515

THE OPPORTUNITY COST OF DISPLACED PRIVATE SPENDING AND THE SOCIAL DISCOUNT RATE,
Grinnell Coll., Iowa.
For primary bibliographic entry see Field 06B.
W70-04516

NEW PRICE POLICIES FOR MUNICIPAL WATER SERVICE,
Indiana Univ., Bloomington.
Jerome W. Milliman.
American Water Works Association Journal, Vol 56, No 2, p 125-131, February 1964. 7 p, 5 ref.

Descriptors: *Marginal cost, *Water rates, *Pricing, *Economic efficiency, *Municipal water, Peak loads, Economic analysis, Joint costs, Separable costs, Fixed costs, Public utilities, Total cost, Investment.
Identifiers: *Cost-classification, *Equal-price rule, *Price discrimination.

Not enough thought has been given to the pricing principles and policies which should govern the efficient use and development of municipal water service. The tradition of low prices for municipal water service should be broken and attention should be given to better application of economic principles in the design of water rate schedules. The underlying principles important for economic efficiency are that consumers served under identical cost conditions should be charged equal prices and that waste service should be priced in such a way that the prices charged each class of service should equal the marginal costs of serving that class. The defect in much of the principles underlying water rates (i.e. that prices should cover the costs distributed to each class of user) is explained along with the applicable concepts of joint and separable costs. A conclusion is made that the present rate structure tends to generate inefficiency and waste of resources. (Murphy-Rutgers)
W70-04522

WATER UTILITY COST TRENDS,
Dade County Water and Sewer Board, North Miami Beach, Fla.; Whitman, Requardt and Associates, Baltimore, Md.; and Cast Bay Municipal Utility District, Oakland, Calif.
For primary bibliographic entry see Field 03D.
W70-04524

COMPARISON OF COSTS OF REMOTE CONTROL AND MANUAL OPERATION,
Gary-Hobart Water Corp., Gary, Ind.
Harry D. Harman.
American Water Works Association Journal, Vol 58, No 1, p 152-156, January 1966.

Descriptors: *Operating costs, *Profits, *Public utilities, Statistics, Economic feasibility, Investment, Engineering, Flow rates, Water quality, Management.
Identifiers: *Labor costs, *Remote-control equipment, *Telemetering equipment.

The article relates the possibilities inherent in telemetering and remote control equipment in the distribution system of water utilities for the purpose of increasing net profits and rates of return by lowering labor costs. The article tells of the experience of a new plant which was designed to minimize maintenance and operating costs and to use any and all tools that appeared to the economically sound. Several of these tools are described in the report and it was found that significant savings were realized. However, it was felt that the advantages and economics of remote-control operation would not be fully realized until further additions are made to the plant. (Murphy-Rutgers)
W70-04528

6D. Water Demand

THE CRITICAL BALANCE: SUPPLY VS DEMAND IN WATER USE,
Geological Survey, Washington, D.C.
C. Richard Murray.
Groundwater Resources Institute Quarterly, Vol 2, No 2, p 14-15, Winter 1969. 2 p, 1 fig, 1 tab.

Descriptors: *Water utilization, *Water supply, *United States, Consumptive use, Water reuse,

Economics, Water resources development, Groundwater, Surface waters, Water costs, Withdrawal, Recharge, Water balance.
Identifiers: Water demand-use relations.

Water supply-water use relationships in the U.S. are briefly reviewed. In 1965, 85% of U.S. water consumption took place in the relatively arid 17 Western States - where only a quarter of the country's supply is found. Increased dependability of supply generally can be obtained through water control measures, such as constructing reservoirs, controlling evaporation, or artificially recharging groundwater aquifers. Withdrawal of fresh ground and surface water in the 48 conterminous states in 1965 was 310 bgd, or approximately three-fourths the dependable fresh supply. Consumption was 77 bgd, about one-fifth the estimated dependable supply. All fresh-water withdrawals in the 17 Western States amounted to about 130 bgd, compared to about 150 bgd for the estimated dependable supply. Consumption amounted to about 66 bgd - 45% of the dependable supply. West of the Mississippi, only the Pacific Northwest has a very favorable supply-demand ratio. Low consumptive use and suitability of discharge water for reuse are important factors in determining to which use the water will be put as the competition for available supply increases. (Knapp-USGS)
W70-04319

QUANTITATIVE ANALYSIS OF WATER RESOURCES IN THE ALBUQUERQUE AREA, NEW MEXICO; COMPUTED EFFECTS ON THE RIO GRANDE OF PUMPAGE OF GROUNDWATER, 1960-2000,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02F.
W70-04392

WATER FOR THE CITIES--THE OUTLOOK,
Geological Survey, Washington, D.C.
William J. Schneider, and Andrew M. Spieker.
Available free of charge from US Geological Survey, Washington, DC, 20240. Geological Survey Circular 601-A, 1969. 6 p, 5 ref.

Descriptors: *Urbanization, *Water distribution, Short-term planning, Water resources development, Treatment facilities, Cities.

Water resources are adequate to meet the anticipated future needs of cities. The demands for urban water, however, will place a heavy strain upon existing systems. Present city problems vis-a-vis water have been the result of overtaxed collection, storage and distribution systems. The governing criteria for most cities in solving their water problems have been short-range ones based upon 'crisis' reactions and minimum costs. Future development of water resources will have to consider regional demands and resources because of: (1) the rapid expansion of urban areas and the concomitant juxtaposition of units of governments; (2) overlapping political jurisdiction; and (3) competing demands for the water resource. (Starr - Chicago)
W70-04423

THE DEMAND AND SUPPLY OF OUTDOOR RECREATION, AN ECONOMETRIC ANALYSIS,
Rutgers - The State Univ., New Brunswick, N.J.
Charles J. Cicchetti, Joseph J. Seneca, and Paul Davidson.
New Jersey, Bureau of Economic Research, 1969. 310 p, 16 fig, 18 tab, 43 ref, 2 append.

Descriptors: *Theoretical analysis, *Demand, *Supply, *Recreation, Statistical methods, Model studies, Least squares method, Regression analysis, Statistical models, Recreation facilities, Planning, Estimating.
Identifiers: *Econometrics, *Socioeconomic characteristics, Mixed goods, Public goods, Private goods, Theoretical model, Reduced form, Two step technique, Identification, Bias, Heteroskedasticity, Probit analysis, Generalized least squares, Empirical model, Conditional probability, National Recreation Survey.

A theoretical analysis is presented of the private and public components of outdoor recreation and formulates the qualitative and quantitative characteristics of outdoor recreation as a commodity. An extension of a Musgrave implied mixed good analysis is used as the theoretical framework of the study. After determining the nature of the outdoor recreation good, a theoretical model of demand and supply is formulated using the results of the mixed good analysis. A discussion is presented pertaining to the econometric problems involved in such a study. A two step, conditional probability sub-sample activity day approach is used to examine 24 outdoor recreation activities in the empirical model. The 1965 National Recreation Survey and an inventory of recreational facilities, substitute goods, complementary goods and socioeconomic characteristic found in each county and state for each of the 2194 sample persons supplied the data. From the empirical model an applied model useful for planners at various governmental levels is determined. The final chapter presents an example of its use along with policy recommendations. The vital role of water resources in outdoor recreation and the potential benefit magnitudes of recreation activity in water projects make this article of interest to the water researcher. (Loeb-Rutgers)
W70-04511

RECREATIONAL TRIP GENERATION, A CROSS SECTION ANALYSIS OF WEEKEND PLEASURE TRIPS TO THE LAKE DISTRICT NATIONAL PARK,
Ministry of Transport, London (England).
N. W. Mansfield.
Journal of Transport Economics and Policy, Vol 3, No 2, p 152-164, May 1969. 13 p, 1 map, 7 tab, 5 ref, 1 append.

Descriptors: *Demand, Recreation, Cross-sections, Costs, Regression analysis, Elasticity of demand, Time.
Identifiers: *Recreational trip generation, *Pleasure trips, *Lake district, Traffic data, Day visitors, Half-day visitors.

The paper attempts to analyze the demand for day and half-day pleasure trips to a holiday area, by means of a model describing the generation of trips to alternative recreation facilities and holiday resorts. The main purpose of the paper is to make a cross-section analysis of a single year's traffic data in order to determine how much of the observed variation in trip demand during a single year can be attributed to a few simple factors affecting relative journey costs. The small sample size of the original data meant that only 15 separate observations of trip volumes were available. The author therefore, suggests that the quantitative results should be interpreted as only general indications of the responsiveness of demand to changes in the variables considered. This methodology might well be used to analyze day pleasure trips to water recreational areas in the United States. (Loeb-Rutgers)
W70-04512

AN INDUSTRIAL WASTE GUIDE TO THE COTTON TEXTILE INDUSTRY.
American Association of Textile Chemists and Colorists, Durham, N.C.

American Association of Textile Chemists and Colorists, National Stream Sanitation Committee and National Technical Task Committee on Industrial Wastes, Public Health Service publication 677, 1959, 23p.

Descriptors: *Cotton, *Sludge Disposal, *Filtration, *Neutralization, *Remedies, *Aeration, Waste water disposal, Waste water treatment, Activated sludge, Lagoons, Separation techniques, Chemical precipitation.
Identifiers: *Biological oxidation, *Slashing wastes, *Dyeing wastes, *Desizing wastes, *Scouring wastes, *Equilization, *Chemical oxidation, Trickling filters, Waste volume reduction, Process modification, Recovery (Wastes), Substitution of chemicals.

This publication is intended to assist operators and managers of cotton textile plants to analyze and solve their waste problems. A description of cotton processing and the sources of pollutants are given. A format for plant analysis discusses and recommends the following: (1) determine the magnitude of the waste problem; (2) find in-plant methods to reduce waste volume or polluting effects-for example, by re-use of water, segregation of wastes, lowering the amounts of process chemicals used, recovery and re-use of chemicals, substitution of chemicals, process modification, or simple good housekeeping; (3) determine the maximum waste load the receiving stream can accept; (4) consider the feasibility of combined treatment with domestic sewage; (5) determine which treatment method gives the best, most economical results. Methods discussed are the separation and differential treatment of wastes, equalization and storage, screening and mechanical filtration, aeration, neutralization, chemical precipitation, and chemical or biological oxidation. A bibliography is included. (Sheffield-North Carolina State Univ)
W70-04541

AN INDUSTRIAL WASTE GUIDE TO THE SYNTHETIC TEXTILE INDUSTRY,
American Association of Textile Chemists and Colorists, Durham, N.C.
Arthur L. Smith.
American Association of Textile Chemists and Colorists Committee of Stream Sanitation Technology, National Technical Task Committee on Industrial Wastes, United States Public Health Service, Washington, D.C., 1965, 23 p, 9 figures, 6 tables, 9 references, Public Health Service Publication No. 1320.

Descriptors: *Separation techniques, Waste treatment, Industrial wastes, Remedies, Biological treatment.
Identifiers: Synthetic fibers, Dyeing wastes, Rayon, Acetate, Polyamides, Polyolefins, Polyesters.

This publication summarizes waste problems associated with processing synthetic fibers and suggests methods of analysis and solutions for the problems. Pollutants from processing rayon, acetate, polyamides, acrylic, polyester, and polyolefin fibers include oils, detergents, finishing wastes, scouring bath wastes, dye wastes, and toxic compounds. Wastes should be checked for toxic materials that might be immune to treatment, discharge load should be determined from in-plant measurements and BOD in the stream should be checked under varying conditions. Two solutions to a waste problem are discussed: (1) reduction of waste through process control, good housekeeping methods, chemical substitution and recovery of components, and (2) treatment of wastes by solids separation or biological treatment. A bibliography is included. (Sheffield-North Carolina State Univ)
W70-04542

6E. Water Law and Institutions

PHYSICAL, LEGAL AND ECONOMIC ASPECTS OF ASSESSMENT OF COSTS AMONG DRAINAGE DISTRICTS: LEGAL PHASE,
Iowa Univ., Iowa City.
N. William Hines, and Frank W. Pechacek, Jr.
Available from the Clearinghouse as PB 189 767, $3.00 in paper copy, $0.65 in microfiche. Completion Report, Iowa State Water Resources Research Institute, Dec 31, 1969. 77 p. OWRR Project B-005-IA.

Descriptors: Watershed management, *Legal aspects, Small watersheds, Land use, *Surface drainage, Supervisory control, *Costs.

Discusses the related problems of multi-purpose versus single purpose districts, and the allocation of costs and benefits. An intoductory background on allocation of costs reviews judicial development of the common law, common energy rule, the civil law rule of natural drainage, the reasonable use rule, and state statutes creating drainage districts. A more specific analysis of Iowa districts observes the piece-meal development of too many districts, often at cross-purposes or duplicative, and laboring under an inherently inequitable system of cost allocation based on the theoretically appealing economic benefit concept. The current legal apparatus is defined as archaic in terms of present population and technological demands. Recommends 'multi-purpose' approach to drainage management, which is joint participation by both upper-land and bottom-land owners with special emphasis upon use of soil-conservation and water-retention structures by the upper-land owners.
W70-04047

SOME ASPECTS OF THE WATER RESOURCES DEVELOPMENT IN INTERNATIONAL RIVER BASINS,
International Inst. for Land Reclamation and Improvement, Wageningen (Netherlands).
F. E. Schultze, and Ch. A. P. Takes.
Int Inst Land Reclam Impr, Annu Rep, p 5-11, The Neth, 1968. 7 p.

Descriptors: Compacts, Watersheds (Basins), Planning, International waters, Project planning, Policy matters, Foreign countries.
Identifiers: *Developing countries, *International river basin, Chad Republic, Mekong River Project, International projects.

Some aspects of international projects are discussed, with special reference to developing countries where outside technical and financial assistance is needed for designing and constructing basinwide water resources systems. Observations deal mainly with the organizational and operational aspects of the problem and reflect the work of the Chad Basin Commission and the Mekong Committee. To guarantee the most efficient use of water resources of a river basin, a basinwide approach to development is needed. When the basin falls under the jurisdiction of different countries, such an approach is more complicated because some specific and inevitable difficulties are encountered. These problems should be recognized and measures should be taken to reduce them. Two main factors that could reduce the difficulties are: (1) a powerful, well-staffed, and well-equipped administrative force; and (2) well-defined action programs. Much depends on the desire of participating countries for cooperation, and on an understanding that communal effort, rather than a shortsighted clinging to direct national interests, will lead to better results for all. (USBR)
W70-04141

RELIEF IN NATURAL DISASTERS,
For primary bibliographic entry see Field 06B.
W70-04174

PROBLEMS OF INFORMATION AND COMMUNICATION,
For primary bibliographic entry see Field 06B.
W70-04176

NAVIGATION: WATER TRANSPORTATION.

N H Rev Stat Ann secs 270:1 thru 270:30 (1966), as amended, (Supp 1967).

Descriptors: *New Hampshire, *Boats, *Boating regulations, *Navigation, Permits, Administrative agencies, Boating, Recreation, Administrative decisions, Taxes, Legal aspects, Inspection, Legislation, Safety, Equipment, Buoys, Navigable waters, Public utilities, Transportation, Inland waterways, Public health, Assessments, Rates, Government finance.
Identifiers: *Registration, *Common carriers.

The Director of Safety Services is given power to: (1) inspect all boats operated on public waters; (2) supervise navigation safety and aids; (3) regulate the operation of all boats; (4) license specified boat personnel; (5) suspend boat registration for certain violations; and (6) regulate and license all proposed boat races. Registration of all boats and outboard motors is required. Fees are collected for this registration. Common carriers must be approved and licensed by the Public Utilities Commission which is also responsible for their regulation. Reciprocity of contiguous state boat registration is provided for. (Dearing-Florida)
W70-04187

GEORGIA WATER LAW (INTRODUCTION: HYDROLOGIC CYCLE; TERMINOLOGY),
R. C. Kates.
In: Georgia Water Law, Institute of Government, University of Georgia, Athens, Georgia, Chapter 1, p 1-14, 1969.

Descriptors: *Georgia, *Hydrologic cycle, *Hydrologic equation, *Water rights, Hydrologic aspects, Surface waters, Water resources, Legal aspects, Legislation, Judicial decisions, Groundwater, Watercourses (Legal), Rivers, Streams, Lakes, Ponds, Piers, Tidewaters, Navigable waters, Riparian rights, Prior appropriation, Accretion (Legal aspects), Avulsion, Fishing, Ownership of beds.
Identifiers: Definitions.

The increase in industrialization and population has created new and urgent problems of private water use and its public regulation. The last major codification of Georgia water law, which occurred in 1860, was not designed to cope with these problems. The purpose of this book is to examine existing Georgia water law. The content of the private right of water use depends upon the broad relationship between these uses and their resultant effect upon other uses. This relationship is expressed in the hydrologic cycle. This hydrologic equation is used herein to explore the resonableness of Georgia water law. Since they generally accord with the hydrologist's classification of water as it moves through the hydrological cycle, the existing legal categories of classification have been retained. These categories and terms are defined in this introduction and include: (1) surface waters; (2) diffused surface waters; (3) groundwaters; (4) watercourse, stream and river; (5) natural watercourse; (6) tidewaters; and (7) pond and lake. Also introduced are the concepts of: (1) navigability; (2) riparian rights; (3) prior appropriation; (4) accretion and avulsion; (5) wharfage rights; (6) fishery rights; and (7) bed ownership. (See Vol. 2 No. 15, Field 6E, entry W69-06009). (Marsee-Florida)
W70-04200

GEORGIA WATER LAW (HISTORICAL BASIS OF GEORGIA RIPARIAN WATER LAW),
R. C. Kates.
In: Georgia Water Law, Institute of Government, University of Georgia, Athens, Georgia, Chapter 2, p 15-23, 1969.

Descriptors: *Georgia, *Riparian rights, *History, *Natural flow doctrin, Relative rights, Obstruction to flow, Diversion, Consumptive use, Judicial decisions, Legislation, Legal aspects, Prior appropriation, Reasonable use, Riparian waters, Alteration of flow, Competing uses, Ownership of beds, Prescriptive rights, Usufructuary right, Water law, Navigable waters.

Georgia follows the modified riparian doctrine. That is, natural flow is subject to reasonable restricted uses. This doctrine emerged in Georgia in the decision of Hendrick v Cook, 4 Ga 241 (1848). It is important to understand various formulations of the riparian rights concept leading to this decision. Early common law attitudes are discussed, including attitudes toward: (1) diversion of water flow by riparian owners; (2) bed ownership; (3) interference with natural flow; (4) fishing rights; (5) prior appropriation; and (6) prescriptive use of nonnavigable stream waters. Early Georgia statutory law is examined as is English and American law immediately prior to 1848. Early law, both statutory and judicial, recognized the natural flow doctrine of riparian rights. However, the doctrine was gradually qualified to prevent the last downstream owners from exercising a virtual monopoly of the consumptive uses of the stream water. (See Vol. 2, No. 15, Field 6E, entry W69-06009). (Marsee-Florida)
W70-04201

GEORGIA WATER LAW (THE GEORGIA DOCTRINE OF RIPARIAN WATER RIGHTS),
R. C. Kates.
In: Georgia Water Law, Institute of Government, University of Georgia, Athens, Georgia, Chapter 3, p 24-84, 1969.

Descriptors: *Georgia, *Riparian rights, *Reasonable use, *Legislation, Judicial decisions, Relative rights, Obstruction to flow, History, Diversion, Consumptive use, Nonconsumptive use, Water pollution, Riparian land, Riparian waters, Navigable waters, Ownership of beds, Alteration of flow, Usufructuary right, State governments, Legal aspects, Impoundments, Irrigation, Domestic water, Competing uses, New York.

Beginning with the early case of Hendrick v Cook, 4 Ga 241 (1848), this chapter examines the development of the riparian rights doctrine in Georgia. The chapter discusses: (1) the 1860 Georgia codification of riparian law; (2) general considerations of reasonable use; (3) domestic uses; (4) irrigation; (5) the non-approved consumptive uses of detention, obstruction, addition of waters, physical injury to adjoining land and pollution; (6) Georgia's resonable use rule applied to modern impoundments; (7) rejection of the doctrine of balancing the conveniences; (8) protection of quasi-public uses; (9) competing uses by governmental subdivisions; and (10) the present riparian doctrine, its shortcomings, and the feasibility of remedial legislation modeled on the New York example. The proposed statute for Georgia provides; (1) that harmless use is not actionable; (2) for amendment of existing code sections; (3) for ownership of beds; (4) for the right of use of navigable bodies of water whose beds are owned by the state; (5) for a definition of riparian land; (6) for declaratory judgments; and (7) for a remedy for harm to riparian rights caused by interference with subsurface waters. (See Vol. 2, No. 15, Field 6E, entry W69-06009). (Marsee-Florida)
W70-04202

GEORGIA WATER LAW (WATER POLLUTION IN GEORGIA),
R. C. Kates.
In: Georgia Water Law, Institute of Government, University of Georgia, Athens, Georgia, Chapter 4, p 85-141, 1969.

Descriptors: *Georgia, *Water pollution control, *Pollution abatement, *Water quality control, Legislation, Pollution, Judicial decisions, State governments, Federal goverment, Cities, Industries, Industrial wastes, Coordination, Administrative agencies, Jurisdiction, Public rights, Regulation, Standards, Abatement, Federal jurisdiction, History, Costs, State jurisdiction.
Identifiers: Definitions.

Although compliance with the water purity standards set forth by the Federal Water Pollution Control Act could result in enormous expenditures by industries and municipalities, it is likely that the public will continue to strive for water pollution abatement. The purpose of this chapter is to study both public and private means of such abatement and to interpret recently enacted federal and state statutes and regulations. The chapter discusses: (1) early pollution regulation; (2) the definitions of pollution; (3) the basis of private liability; (4) civil liabilities of municipalities; (5) liability of industry;

(6) reform legislation; (7) exercise of the state's police power; (7) stream classification according to use; (8) quality standards and state enforcement thereof; (9) federal and state enforcement jurisdiction and procedures; (10) public regulation; and (11) private law suits as a deterrent to pollution. Often, judicial and administrative processes work at cross-purposes. What is needed in Georgia is a closer relationship between the courts and the regulating agency so that the powers of each may be effectively combined in the regulation of pollution. (See Vol. 2, No. 15, Field 6E, entry W69-06009). (Marsee-Florida)
W70-04203

GEORGIA WATER LAW (NAVIGABLE STREAMS, TIDEWATERS),
R. C. Kates.
In: Georgia Water Law, Institute of Government, University of Georgia, Athens, Georgia, Chapter 5, p 142-183, 1969.

Descriptors: *Georgia, *Navigable waters, *Tidewaters, *Relative rights, Ownership of beds, Federal jurisdiction, Federal government, State governments, Interstate compacts, Jurisdiction, Riparian rights, Regulation, Legislation, Legal aspects, Judicial decisions, Non-navigable waters, Navigable streams, Riparian lands, Riparian waters, Recreation, Navigation, Fishing, Watercourses (Legal), State jurisdiction, Federal-state water rights conflicts.
Identifiers: Constitutions, Powers.

Because of the size and number of navigable waterways and tidewaters in Georgia, the law relating thereto is of primary concern as important commercial, navigation, recreational, and fishing interests are determined thereby. Navigable streams, non-navigable tidewaters, and tidewaters are defined, and the chapter discusses: (1) the rights and liabilities of adjacent landowners in non-tidal navigable streams, navigable tidewaters, and non-navigable tidewaters; (2) ownership of beds; (3) 1863 Georgia legislation changing common law rights in navigable streams; (4) federal powers, restrictions and requirements; (5) the impact of federal powers on state water law; (6) the relation of federal law to state police power; and (7) the relation of federal law to individual property rights. Federal powers examined include: (1) the war power; (2) the taxing and general welfare powers; (3) the property clause powers; (4) interstate compact powers, and (5) powers relating to disputes between states. This chapter attempts to delineate the respective authority of federal and state governments in relation to Georgia waters, to explore the constitutional protections given private property from unauthorized governmental taking, and to analyze the rights of riparian owners on navigable streams. (See Vol. 2, No. 15, Field 6E, entry W69-06009). (Marsee-Florida)
W70-04204

GEORGIA WATER LAW (LAKES AND PONDS),
R. C. Kates.
In: Georgia Water Law, Chapter 6, p 184-209, Institute of Government, University of Georgia, Athens, Georgia, 1969.

Descriptors: *Georgia, *Lakes, *Ponds, *Relative rights, Ownership of beds, Navigable waters, Non-navigable waters, Fishing, Boating, Swimming, Legislation, Judicial decisions, Public rights, Reasonable use, Artificial watercourses, Land tenure, Regulation, Recreation, Recreation demand, Developed waters, Shores, Legal aspects.

The development of artificial or natural lakeside residential areas and the greater pressures of recreational needs in such waters increasingly call for clearer definitions of the legal rights of interested parties, including members of the public. However statutory and case law in Georgia provides little guidance in this area. This chapter examines the existing Georgia law and discusses: (1) title to the beds of artificial, natural, and non-navigable lakes and ponds; (2) rights of owners of beds of lakes and ponds; (3) the right of adjacent owners to reasonably use the surface waters of non-navigable lakes; (4) existing public regulation relating to use of non-navigable lakes; (5) legal theory to support additional regulation relating to use of non-navigable lakes; (6) public rights in lakes and their possible extension; and (7) regulation of fishing, boating, and bathing. The desirability of public development of lakes, ponds, and shoreline is weighed against private development thereof. (See Vol. 2, No. 15, Field 6E, ENTRY W69-06009). (Marsee-Florida)
W70-04205

GEORGIA WATER LAW (DIFFUSED SURFACE WATERS),
R. C. Kates.
In: Georgia Water Law, Chapter 8, p 210-226, Institute of Government, University of Georgia, Athens, Georgia, 1969.

Descriptors: *Georgia, *Surface runoff, *Surface waters, *Relative rights, Drainage, Beneficial use, Judicial decisions, Legislation, Legal aspects, State governments, Obstruction to flow, Repulsion (Legal aspects), Civil law, Riparian rights, Impoundments, Drainage water, Riddance (Legal aspects), Discharge (Water), Prescriptive rights, Diffusion, Evaporation.
Identifiers: Definitions.

Diffused surface waters are distinguished from natural watercourses in that the former have no natural boundaries or permanency and are not part of any defined surface or subterranean stream of water. Their source is precipitation, melting snow or percolation from the ground. They differ from groundwaters in that they are found on the surface of the earth and are temporary in nature, being evaporated or diffused by natural drainage. Most surface water law is concerned with land drainage rights and liabilities between private parties. In Georgia the law of surface waters is the product of judicial decision rather than statute. That decisional law is examined herein within the framework of the opposing common enemy and civil rule theories. The chapter discusses: (1) the general drainage law in Georgia; (2) discharge of surface water by artificial means; (3) case law and statutory law; (4) obstruction of flow and prescription; (5) pollution; (6) beneficial use; and (7) the relation of the right of collection for beneficial use to the law of riparian rights. (See Vol. 2, No. 15, Field 6E, entry W69-06009). (Marsee-Florida)
W70-04206

GEORGIA WATER LAW (SUBTERRANEAN WATERS, PERCOLATING WATERS SUBTERRANEAN STREAMS, SPRINGS),
R. C. Kates.
In: Georgia Water Law, Chapter 8, p 227-244, Institute of Government, University of Georgia, Athens, Georgia, 1969.

Descriptors: *Georgia, *Underground streams, *Percolating water, *Subsurface waters, Legal aspects, Springs, Legislation, Judicial decisions, Reasonable use, Wells, Well regulation, Hydrologic cycle, Hydrologic equation, Relative rights, Land tenure, Underflow, Underground, Water sources, Regulation, Social change, Groundwater, Water table, Water resources.

Because of the inherent difficulties in demonstrating with legal precision the physical characteristics of underground waters, such waters have been assigned an arbitrary legal classification that disregards the hydrological interrelationship of diffused surface waters, subterranean stream, and natural surface bodies. Georgia cases give little consideration to the lowering of a water table through excessive withdrawals of groundwater. The concept of absolute dominion over underlying groundwaters is a product of social and economic conditions existing when water was plentiful and population pressures few. A change in these factors requires a re-examination of the prior decisional law in Georgia. This chapter discusses Georgia decisional and statutory law as it relates to: (1) absolute ownership, reasonable use and correlative rights in percolating waters; (2) subterranean streams; (3) springs and wells; and (4) regulation of underground waters. The chapter concludes that the existing Georgia law of property rights in underground waters, as well as the public regulation thereof, is inadequate. This is partially caused by the courts' failure to expressly adopt the reasonable use rule. A statute relating to the use of underground waters is proposed for enactment. (See Vol. 2, No. 15, Field 6E, entry W69-06009). (Marsee-Florida)
W70-04207

GEORGIA WATER LAW (PROCEDURES AND REMEDIES),
R. C. Kates.
In: Georgia Water Law, Chapter 9, p 245-305, Institute of Government, University of Georgia, Athens, Georgia, 1969.

Descriptors: *Georgia, *Legal aspects, *Remedies, *Adjudication procedure, Water quality control, Legislation, Judicial decisions, Regulation, Governments, State governments, Federal government, Administrative agencies, Assessments, Drainage districts, Pollution abatement, Condemnation, Permits, Public rights, Damages, Administration.

As related to Georgia water law, this chapter discusses: (1) state proceedings; (2) parties at interest; (3) pleadings; (4) measure of damages; (5) injunctions; (6) involvement of the public interest; (7) procedure under the Water Quality Control Act; (8) permits; (9) pollution abatement; (10) condemnation proceedings; (11) statutory procedures; (12) remedies; (13) federal condemnation proceedings; (14) special assessments for drainage districts; and (15) formation of agency regulations. (See Vol. 2, No. 15, Field 6E, entry W69-06009). (Marsee-Florida)
W70-04208

GEORGIA WATER LAW (ADMINISTRATIVE STRUCTURE OF WATER USE AND WATER COURSES REGULATION),
R. C. Kates.
In: Georgia Water Law, Chapter 10, p 306-331, Institute of Government, University of Georgia, Athens, Georgia, 1969.

Descriptors: *Georgia, *Administrative agencies, *Regulation, *Administration, Coordination, Institutions, Organizations, Adjudication procedure, Federal government, Permits, State governments, Administrative costs, Leadership, Interstate commissions, Cities, Drainage districts, Water districts, Water users, Southeast U.S., Atlantic Coastal Plain, Public health, Fishing, Agriculture, Forestry.

Besides the Water Quality Control Board, numerous other non-federal units and agencies in Georgia are empowered to exercise varying degrees of control over water use. Many of these bodies are classified in this chapter according to the level of government at which the particular controls are exercised: (1) agencies functioning interstate; (2) state departments and commissions; (3) special purpose districts; (4) counties, municipalities and other public corporations; and (5) quasi-public corporations. Bodies discussed include: (1) Atlantic States Marine Fisheries Commission; (2) Resources Advisory Board; (3) Commission on Interstate Cooperation; (4) Southeastern Basin Inter-agency Committee; (5) Department of Agriculture; (6) Division of Conservation; (7) Department of Industry and Trade; (8) Department of Public Health; (9) Game and Fish Commission; (10) Forestry Commission; (11) Georgia Recreation Commission; (12) Mineral Leasing Commission; (13) Public Service Commission; (14) Rivers and Harbors Development Commission; (15) Soil and Water Conservation Commit-

tee; (16) drainage districts; (17) soil and water conservation districts; (18) sanitation districts; (19) counties; and (20) municipalities. The chapter also examines recent reorganizational developments in the administrative structure of Georgia water use control, and notes overlaps of authority and duplications of functions. (See Vol. 2, No. 15, Field 6E, entry W69-06009). (Marsee-Florida)
W70-04209

WATERWAYS AND MILLDAMS.
Ky Rev Stat Ann secs 182.170-182.240 (1963).

Descriptors: *Kentucky, *Condemnation, *Mill dams, *Dams, Legislation, State governments, Dam construction, Administrative agencies, Flood control, Damsites, Regulation, Boundaries (Property), Condemnation value, Cost repayment, Economic impact, Industrial use (Water), Riparian rights, Legal aspects, Canals, Navigation, Fish passages, Public health.

In order to build a mill or factory, a riparian landowner may obtain permission and acquire sufficient land by condemnation to build a dam across any watercourse on which his property is located and whose bed is owned by him or the state. Condemnation proceedings are to be in accordance with this act and brought in the county in which the condemned lands are situated. The appointed condemnation commissioners must report to the county court their findings as to: (1) what ought to be the height of the dam; (2) whether homes or gardens will be overflowed; (3) whether navigation and fish passage will be obstructed; (4) whether health conditions will be impaired; (5) a metes and bounds description of the lands to be taken; (6) what would be just compensation for the lands taken; and (7) whether a mill or factory would be helpful to the public. Permission to construct is within the court's discretion. Servient landowners may construct any structure which will not interfere with permitted water flow. No vested water interests may be violated. Time limitations on building the dam and mill or factory are imposed. (Barnett-Florida)
W70-04220

DESTROYING BRIDGES AND INJURING CANALS.
Va Code Ann secs 18.1-81, 18.1-147 (1960).

Descriptors: *Virginia, *Bridges, *Dams, *Canals, Legislation, Locks, Damages, Burning, Explosives, Explosions, Public utilities, Electric power, Electric wires, Electric switches, Legal aspects, Obstruction to flow.
Identifiers: Penalties (Criminal).

Burning or in any way maliciously destroying any bridge, lock, or dam is made punishable by imprisonment for from one to ten years. It is declared unlawful to maliciously obstruct or damage canals, electric power lines, or bridges. (Schram-Florida)
W70-04222

DREDGING OR SCRAPING FOR OYSTERS.

Va Code Ann secs 28.1-128 thru 28.1-135 (1969).

Descriptors: *Virginia, *Oysters, *Administrative agencies, *Dredging, Legislation, Administrative decisions, Regulation, Commercial shellfish, Shoals, Beds, Ownership of beds, Permits, Boats, Taxes, Tax rate, Legal aspects, Commercial fishing.
Identifiers: *Dredging equipment, *Oyster beds.

It is declared unlawful: (1) to take and catch oysters with dredges and scrapes from any public rocks, beds, or shoals; (2) to have dredging equipment aboard a boat unless a dredging license or permit is available for inspection on the boat; and (3) to allow licensed dredging equipment to be transported on board a boat except in certain instances. The Marine Resources Commission may authorize the use of dredges upon public beds and shoals of Tangier Sound during December, January, and February. The procedures for applying and issuing dredging licenses are detailed. Taking or catching oysters, except with ordinary oyster tongs or by hand, is prohibited and declared a felony. A license tax for dredging is provided. Dredging or scraping for oysters upon private oyster-planting grounds by those licensed for such activities is permitted under stated conditions. This privilege is further conditioned upon properly marking the oyster lines of the planting grounds with fixed buoys. The Marine Resources Commission is authorized to revoke all permits and licenses for one year for violation of these dredging provisions. A hearing is required for such revocation. (Schram-Florida)
W70-04224

OYSTER REGULATIONS.

Va Code Ann secs 28.1-136 thru 28.1-142 (1969).

Descriptors: *Virginia, *Shellfish, *Oysters, *Clams, Legislation, Administrative agencies, Administrative decisions, Commercial fishing, Crabs, Commercial shellfish, Legal aspects, Lime, Measurement, Regulation, Permits, Marine fisheries.

It is illegal to carry away oysters or clams or to take shells or seeds that have been planted for the formation of oyster beds. Anyone found guilty of taking oysters from public grounds shall, without notice or hearing, have any existing licenses to take or catch finfish or shellfish revoked. No new licenses shall be issued to such person for a minimum of one month. Except with the permission of the Marine Resources Commission, it is unlawful to take or catch oysters or shells for the purpose of converting them into lime. Taking or loading shellfish on Sunday nights is prohibited. It is unlawful to sell or distribute oysters or clams as Virginia oysters or clams unless they have been in the waters of Virginia for at least six months. It is unlawful for any boat licensed to catch crabs with a dredge to allow more than one bushel of oysters on board. (Schram-Florida)
W70-04225

FISH, OYSTER, AND SHELL FISH.
Va Code Ann secs 28.1-143 thru 28.1-159 (1969).

Descriptors: *Virginia, *Oysters, *Shellfish, *Administrative agencies, Legislation, Chennels, Channel improvement, Dredging, Leases, Beds, Ownership of beds, Navigable streams, Rivers, Shoals, Crabs, Clams, Agriculture, Commercial shellfish, Width, Depth, Length, Boundaries (Property), Surveys.
Identifiers: *Advisory reports.

It is unlawful to use rakes or scrapes to take oysters, crabs, clams, or shells from the beds, rocks, and shoals on the ocean side of Accomack and Northampton counties. The deep water planting grounds of the James and Rappahannock rivers are part of the public oyster beds and may not be leased or assigned by the Commission of Fisheries. Dredging for oysters in the James River is prohibited unless a permit has been granted. After receiving advisory reports from various state agencies, the Governor may authorize the dredging of channels of navigable streams whose beds are owned by the state. Channel improvements in the James River must be approved by the General Assembly. Certain areas are declared to be natural oyster rocks, beds, and shoals and are made unassignable for private use. Detailed descriptions of these areas are included. Certain acts declaring other areas to be natural oyster beds, rocks, and shoals are continued in force. (Schram-Florida)
W70-04226

COUNTY BRIDGES.

Ohio Rev Code Ann secs 5591.01 thru 5591.44 (Page, 1953).

Descriptors: *Ohio, *Bridges, *Bridge construction, *Local governments, Legislation, Legal aspects, Railroads, Bridge design, Administration, Streams, Canals, Boats, Highways, Road construction, Construction, Costs, Tax rate, Easements, Taxes, Cities, Bodies of water

The board of county commissioners must construct and repair all necessary bridges over streams and public canals in municipal corporations not participating in the bridge fund. They may also issue bonds, which may be submitted to the electorate; acquire all lands and easements necessary; construct and maintain swing or lift bridges; purchase toll bridges; maintain and operate a free ferry; and, may enter into contracts with railroad companies for the joint construction, operation and use of bridges designed to carry railroad and general highway traffic. The board may establish new highways and approaches to bridges and may modify or alter existing bridges, highways and approaches. Authority is granted to these boards to maintain suits for damages to bridges under their control. (Casey-Florida)
W70-04227

SOUTH VENICE CORP V CASPERSEN (OWNERSHIP OF BEDS).
229 So 2d 652-657 (2d DCA Fla 1969).

Descriptors: *Florida, *Ownership of beds, *Boundaries (Property), *Boundary disputes, Nonnavigable waters, Navigable waters, Islands, Swamps, Bulkhead line, Dredging, Beds under water, High water mark, Watercourses (Legal), Legal aspects, Judicial decisions, Riparian rights, Bays.

Defendant corporation applied for a permit to establish a bulkhead line and dredge fill for an area which included an island and a portion of the submerged bottom of Lemon Bay in Sarasota County. Plaintiff Caspersen sought determination that he was the owner of the island and the submerged bottom. Plaintiff had earlier conveyed property 'east of Lemon Bay' to defendants. The trial court held that the portion of Lemon Bay in question was nonnavigable. Therefore, plaintiff was the owner of the submerged beds. The common property line between plaintiff's and defendant's tracts of land was the mean high water line of Lemon Bay adjacent to defendant's uplands. The island in question, being at the mouth of a creek, was in the bay and not in the creek, and therefore was not covered by the conveyance. The appellate court affirmed, holding that the bed of the non-navigable bay was in effect 'swamp and overflowed lands'. As land generally does not pass under a deed as appurtenant to land, the submerged beds did not pass to defendant under the riparian rights included in the original conveyance. The court held that as the bay was non-navigable, plaintiff validly had title to the submerged beds and the proper boundary between defendant's uplands and plaintiff's beds was the mean high water line of the bay. (Caldwell-Florida)
W70-04233

RAFTS AND BOOMS - INCORPORATION OF COMPANIES.
Mo Ann Stat secs 422.010, 422.070, 422.090 thru 422.120, 422.160 thru 422.180, 422.210 thru 422.230 (1952).

Descriptors: *Missouri, *Lumbering, *Water rights, *Lumber, Industries, Water management (Applied), Legislation, Legal aspects, Forest management, Construction materials, Pulp and paper industry, Engineering structures, Navigable waters, Streams, Rivers, River systems, Water utilization.
Identifiers: *Booms.

Any five or more persons associated for the purpose of engaging in and carrying on the business of running, driving, booming and rafting logs, timber, lumber, and other floatables on any Missouri waters or for constuction of booms across or in any such waters, may be incorporated. Every corporation is authorized to construct, use and maintain all

necessary booms for the business of such corporation. Such corporations have the power to carry on the business of driving, booming, rafting and running logs, timber, lumber or other floatables. In conducting the above activities, the corporation has a lien on the logs, timber or other floatables driven, boomed, rafted or run. The corporation is entitled to retain the possession of such logs, timber, lumber or other floatables or so much thereof as may be necessary to satisfy operational charges. Any corporation may break jams of logs, timber or lumber in or upon rivers, creeks, or streams. Specific provisions prescribe a system of marking logs, lumber or other timber. The recovery of drifted timber is regulated. (Powell-Florida)
W70-04235

RECREATION, FISH, WILDLIFE FACILITIES.

Mo Senate Bill No 58, Act 91 (Legis Service No 2, 1969).

Descriptors: *Missouri, *Recreation, *Recreation facilities, *Wildlife, Legislation, Administrative agencies, Administrative decisions, Reservoirs, Federal government, Federal project policy, Cost sharing, Projects, Contracts, Costs, Reservoir management, Wildlife conservation, Reservoir fisheries, Multiple-purpose reservoirs, Reservoir operation, Separable costs, Water policy, Maintenance, Natural resources, Conservation, Water resources development.

The Missouri Federal Water Projects Recreation Fund is created. The General Assembly of Missouri may transfer money from the General Revenue Fund to the Recreation Fund and may appropriate money from the Fund to pay non-federal costs associated with the enhancement of recreation and fish and wildlife benefits on federal reservoir lands and waters as required by the Federal Water Projects Recreation Act. Unexpended balances in the Fund at the end of the appropriation period shall not be transferred to the General Revenue Fund. The Interagency Council for Outdoor Recreation shall make an annual report containing all reports and recommendations submitted to the Council from the responsible state agencies. The Council, with the approval of the pertinent state agency, may enter into agreements to administer federal project land and water areas for recreation or fish and wildlife enhancement in accordance with the Federal Water Projects Recreation Act. The Council may indicate the intent of Missouri to bear not less than one-half of the separable costs of the project allocated to those purposes and to bear all operation, maintenance, and replacement costs. (Schram-Florida)
W70-04239

THE NATIONAL ESTUARINE POLLUTION STUDY - VOLUME I.
Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 05C.
W70-04299

THE NATIONAL ESTUARINE POLLUTION STUDY - VOLUME III.
Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 05C.
W70-04301

NAVIGATION: WATER TRANSPORTATION (BOAT REGISTRATION, COMMON CARRIERS).

NH Rev Stat Ann secs 270:1 thru 270:9 (1966), as amended, (Supp 1967).

Descriptors: *New Hampshire, *Boats, *Permits, *Navigation, Administrative agencies, Taxes, Inspection, Equipment, Buoys, Transportation, Navigable waters, Inland waterways, Tidal waters, Public health, Safety, Assessments, Engineering personnel, Personnel, Government finance, Public utilities, Boating regulations, Boating, Legislation, Rates.
Identifiers: *Registration, *Common carriers, Obstruction to navigation.

Boat dealers may be assigned a general registration certificate and number to be used on all boats and motors kept for sale. Any boat propelled by a gas, gasoline or naphtha engine or motor, except when operated in a licensed boat race, must be equipped with an under-water exhaust or other muffling device. It is unlawful to remove or injure any buoy, beacon or other aid to navigation or to moor any vessel thereto. It is also unlawful to place any obstructions to navigation in the navigable waters of the state. Any prearranged boat race must be approved and licensed by the Director of Safety Services. (Dearing-Florida)
W70-04327

NAVIGATION: WATER TRANSPORTATION (BOAT REGISTRATION AND REGULATION).

N H Rev Stat Ann secs 270:10 thru 270:17-a (1966).

Descriptors: *New Hampshire, *Boats, *Permits, *Boating regulations, Boating, Transportation, Public utilities, Personnel, Administrative agencies, Decision making, Administrative decisions, Legal aspects, Inspection, Equipment, Taxes, Government finance, Training, Accidents, Legislation, State governments, Political aspects, Safety.
Identifiers: *Reports, *Records, Hearings.

The Public Utilities Commission may require common carriers by water to submit annual reports, keep records and exhibit all accounts and records to the Commission. The Director of Safety Services may: (1) make and enforce rules and regulations concerning the personnel, operation, and equipment of any boat in public waters; (2) regulate the maximum horsepower of boat engines or outboard motors, and the speed limits in public waters; and (3) prohibit the use of motor boats on small waterbodies. Certificates granted to commercial boats or their personnel and any boat registration may be revoked and criminal sanctions imposed for violation of this act or any rules or regulations prescribed by the Department of Safety. Power boats owned by non-residents and registered in a contiguous state may be operated in this state without additional registration if the registering state reciprocates. (Dearing-Florida)
W70-04345

MILLER V PRARIE CANAL CO (ACCESS RIGHTS OF OWNER OF CANAL EASEMENTS).

229 So 2d 752-755 (3d Cir La 1969).

Descriptors: *Louisiana, *Canals, *Easements, *Damages, Right-of-way, Access routes, Maintenance, Relative rights, Levees, Conveyance structures, Repairing, Channel improvement, Width, Project purposes, Land use, Non-consumptive use, Reasonable use, Canal embankments, Remedies, Legal aspects, Judicial decisions, Competing uses.
Identifiers: Right of access.

Plaintiff landowner brought action against defendant owner of canal servitude through plaintiff's land for damages to land and fences arising out of an alleged trespass when defendant entered plaintiff's land to clean and maintain the canal and construct new levees. From a verdict for defendant, plaintiff appealed. The court affirmed and held that defendant's ownership of the canal right-of-way implicitly carried with it a right to use the canal for its intended purpose without the consent of the owner, and concluded that the owner of a canal easement had the right to enter plaintiff's property without his consent as a means of access to the canal for the purposes of cleaning, maintenance, and construction. The canal owner had no right to cause unnecessary damage to the plaintiff's land, but as it was not shown that the canal was unnecessarily widened beyond the reserved right-of-way, or that plaintiff suffered unnecessary damage to his land or fences in construction of the new levees, the trial court properly found for defendant. (Caldwell-Florida)
W70-04362

NAVIGATION: WATER TRANSPORTATION (BOAT REGISTRATION AND REGULATION, NAVIGATION).

N H Rev Stat Ann secs 270:18 thru 270:30 (1966).

Descriptors: *New Hampshire, *Boats, *Boating regulations, *Permits, Regulation, Legal aspects, Payment, Recreation, Navigation, Buoys, Safety, Navigable waters, Aircraft, Administrative agencies, Streams, Boating, Water sports, Legislation.
Identifiers: Beacons.

The Director of Safety Services, Department of Safety, shall supplement United States inspection laws by inspecting all commercial and private boats on public waters. The Director shall also supervise navigation safety and navigation aids including all lights and buoys. Registration of all commercial and private boats and all outboard motors is required. Fees are required for such registration, for inspection of commercial vessels, and for the issuance of boat operator's licenses and dealers certificates. Boats operating as common carriers with regular routes and schedules on the public waters must be authorized to do so by the Public Utilities Commission. Application for such authorization will be granted if the need for such service is shown and if the applicant is fit, willing, and able to perform the service and to conform to the applicable rules. Every common carrier by water shall establish, publish and maintain rates for transportation of passengers or property. (Dearing-Florida)
W70-04389

FLOOD PLAIN MANAGEMENT STRATEGY: AN ANALYSIS,
Chicago Univ., Ill. Center for Urban Studies.
For primary bibliographic entry see Field 06B.
W70-04424

BRIDGE CORPORATIONS.

Mo Ann Stat secs 351.035, 351.040 (1963).

Descriptors: *Missouri, *Bridges, *Cities, Legislation, Bridge construction, Streams, Rivers, Land use, Eminent domain, Structures, Contracts, Local governments, Transportation, Mechanical equipment, Roads, Access routes, Damages, Operation and maintenance.

Bridge corporations are authorized to construct and maintain bridges for public use over streams within or bordering the state or within any adjoining state. The construction and operation of toll bridges is authorized. Bridge corporations are given the power to charge reasonable tolls and construct access routes to the bridge. The consent of municipal authorities must be obtained for the construction of such bridge within city limits. The power to make contracts for the use of the corporation's property by lease or otherwise is expressly granted. Such bridge corporation has the power to construct and maintain approaches for said bridge or viaduct in any street or alley of any such incorporated city or town in this state. In effect, this gives the bridge company the power of eminent domain, subject to the consent of the municipality involved. Such consent may not be granted until all damages to abutting property have been ascertained and paid. (Caldwell-Florida)
W70-04427

A RIVER DIES--AND IS BORN AGAIN,
For primary bibliographic entry see Field 05G.

W70-04428

THE REBIRTH OF A RIVER,
For primary bibliographic entry see Field 05G.
W70-04436

ABANDONMENT OF ROADS FOR FLOODING.
Va Code Ann secs 33-82 thru 33-95, 33-97 (1953).

Descriptors: *Virginia, *Highway relocation, *Dams, *Cities, Legislation, Highways, Right-of-way, Road construction, Roads, Flood control, Floodgates, Flooding, Flood damage, Submergence, Spillways, Water works, Water supply, Earth dams, Dam construction, Dam design, Dam failure, Dam foundations, Floodgates, Streams, Obstruction to flow.

State roads flooded by the expansion of a municipal water works system outside its corporate limits may be abandoned only if the city has complied with the procedures provided. Upon approval of the relocation by the county, the city submits relocation plans to the State Highway Commission. Upon approval of the plans by the Commission, the city acquires rights of way and constructs the highway at its own expense. Upon completion, the highway becomes a part of the state highway system. Owners of dams are required to maintain those supporting state highways. The Commission may widen or strengthen dams or bridges to support traffic. If a dam is washed out, the owner may pay a portion of the cost of reconstruction to the Commission. If he refuses, the Commission may reconstruct the highway without the owner's consent. If a dam is partially washed away because of an inadequate spillway, it may not be restored unless the spillway is improved, in part at state cost. Statutes declaring certain streams to be highways are continued in force. (Douberley-Florida)
W70-04482

HIGHWAYS, BRIDGES AND FERRIES.
Va Code Ann secs 33-169 thru 33-171, 33-174 thru 33-178, 33-181, 33-182, 33-191, 33-202, 33-203 (1953).

Descriptors: *Virginia, *Rivers, *Boats, *Transportation, Legislation, Regulation, River regulation, Streams, Highways, Transfer, Eminent domain, Interstate rivers, Navigable rivers.
Identifiers: *Ferries.

A fine is provided for transporting persons or property on a watercourse within one half mile of a lawfully established ferry. The operator of a ferry on a watercourse bounding the state and within two miles of an authorized ferry must pay the lawful operator a sum for each crossing. A person who wishes to establish a ferry must post a public notice and apply to the county or municipal court. Viewers are appointed to determine whether public convenience will result from the proposed ferry. If the watercourse divides two counties or a county and a city, applications must be made to both governmental units. No ferry may be authorized within half a mile of another ferry. A penalty is provided for operating a ferry without the proper authority. When a ferry which transports vehicles as a part of a highway system cannot or is not being operated, the highway commissioner upon approval by the Governor may acquire the ferry and necessary facilities by eminent domain for temporary use by the highway system. (Douberley-Florida)
W70-04490

APPROPRIATION OF PROPERTY.

Ohio Rev Code Ann sec 719.01 (Page 1953), as amended, (Supp 1970).

Descriptors: *Ohio, *Cities, *Real property, Legislation, Levees, Wharves, Aqueducts, Canals, Ditches, Drains, Sewers, Sewage treatment, Waste treatment, Sewage disposal, Water supply, Appropriation, Reservoir storage, Pumping plants, Water wells.

Any municipal corporation may appropriate, enter and hold real property within its limits for levees, wharves, landings, bridges and aqueducts. Property may also be held for constructing or improving any canal or watercourse not owned by the state or by an individual authorized to make improvements. Other authorized purposes for holding land include sewers, drains, ditches, and sewage disposal plants. To provide for a water supply, a municipality may appropriate property within or without its limits. (Douberley-Florida)
W70-04531

HAUSEY V RONALDSON (BOUNDARY DISPUTES).
228 So 2d 759-763 (1st Cir 1969).

Descriptors: *Louisiana, *Boundary disputes, *Boundaries (Property), Islands, Real property, Legal aspects, Swamps, Bogs, Marshes, Surveys, Bayous, Rivers, Junctions, Boundaries (Surfaces), Streams, Drainage programs, Drainage, Drainage effects, Dredging.
Identifiers: *Natural boundaries.

Plaintiffs sought a declaratory judgment to determine the true ownership of a portion of an island. The plaintiffs' claim to the land was based on record title and possession. The defendants' contention was based on a deed which had conveyed to defendants' predecessor in title 203 acres of land. Defendants asserted that the disputed 29 acres made up the balance of the 203 acres described in their chain of title. In affirming the decision of the trial court, the Court of Appeal of Louisiana held that the natural boundaries described in the plaintiffs' chain of title were superior to defendants' quantity calls. The court ruled that both chains of title contained unclear boundary descriptions but granted judgment to the plaintiffs based upon their chain of title which particularly recited that the property extended to and was bounded by the Comite River on the south. Defendants additionally asserted that by granting title to the disputed land to the plaintiffs, the quantity of acreage described in the plaintiffs' chain of title would be exceeded. The court declared, nowever, that the natural boundaries described in plaintiffs' chain of title required such a finding. (Schram-Florida)
W70-04534

WATERCRAFT REGULATION.
For primary bibliographic entry see Field 05G.
W70-04535

6F. Nonstructural Alternatives

FLOOD-HAZARD MAPPING IN METROPOLITAN CHICAGO,
For primary bibliographic entry see Field 04A.
W70-04170

THE ECONOMICS OF NATURAL DISASTERS: IMPLICATIONS FOR FEDERAL POLICY,
For primary bibliographic entry see Field 06B.
W70-04172

THE NEED FOR COMPREHENSIVE DISASTER INSURANCE,
For primary bibliographic entry see Field 06B.
W70-04181

WISE USE OF FLOOD PLAINS (STATE FLOOD CONTROL REGULATION).
For primary bibliographic entry see Field 04A.
W70-04215

WISE USE OF FLOOD PLAINS (RECOMMENDATIONS FOR WISE FLOOD PLAIN MANAGEMENT).
For primary bibliographic entry see Field 04A.
W70-04217

EFFLUENTS AND AFFLUENCE,
New England Interstate Water Pollution Control Compact.
For primary bibliographic entry see Field 05G.
W70-04429

6G. Ecologic Impact of Water Development

WATER QUALITY MANAGEMENT, FIRST ANNUAL REPORT FOR PERIOD ENDING JUNE 30, 1969.
Miami Conservancy District, Dayton, Ohio.
For primary bibliographic entry see Field 05G.
W70-04096

THE NATIONAL ESTUARINE POLLUTION STUDY - VOLUME I.
Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 05C.
W70-04299

THE NATIONAL ESTUARINE POLLUTION STUDY - VOLUME III.
Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 05C.
W70-04301

EFFECTS OF WEATHER MODIFICATION ON PLANT AND ANIMAL COMMUNITIES,
Michigan Univ., Ann Arbor. School of Natural Resources.
For primary bibliographic entry see Field 02B.
W70-04391

ECOSYSTEM SCIENCE AS A POINT OF SYNTHESIS,
S. Dillion Ripley, and Helmut K. Buechner.
Daedalus, Vol 96, No 4, p 1192-1199, Fall 1967. 2 ref.

Descriptors: *Ecosystems, *Methodology, *Planning, Ecology, Environment.
Identifiers: Levels of integration, Points of view.

A two-dimensional conceptual model is presented, based on levels of integration and points of view, as an aid in orienting knowledge with relevance to the ecological crisis. The first dimension of the model considers levels of biological integration in terms of ecosystems. Biological entities, such as cells, organisms, populations, and communities, represent levels of integration in which the whole is more than a mere sum of the parts. Any of these levels of integration can be considered an ecosystem if the total environment is added as an integral part of the system. The societies of man, together with their total environment, form the highest level of biological integration. Man's societies dominate all ecosystems on earth. Accordingly, we need to concentrate our orientation of knowledge on the human-society-plus-environment level of integration because of its relevance to the central world problem of achieving a reasonably steady state between human societies and the finite resources of our planet. The second dimension of the conceptual model concerns points of view. Any entity may be studied from the following points of view: (1) the components of the system; (2) structure or morphology; (3) functions and processes; (4) distribution in time; (5) distribution in space; (6) relationships to environment; and (7) classification. These are related to the human-society-plus-environment level of integration. (Davis-Chicago)
W70-04433

07. RESOURCES DATA

7A. Network Design

REDEFINITION OF SALINITY,
Scientific Committee on Oceanic Research (Gt. Brit.); International Council for the Exploration of the Seas; and International Association for the Physical Sciences of the Ocean.
Warren S. Wooster, Arthur J. Lee, and Gunter Dietrich.
Journal of Marine Research, Vol 27, No 3, p 358-360, Sept 15, 1969. 3 p, 6 ref.

Descriptors: *Sea water, *Salinity, *Analytical techniques, *Conductivity, *Water analysis, Water properties, Water chemistry, Electrolytes.
Identifiers: Salinity determination, Chlorinity.

With the development of precise methods for measuring the electrical conductivity of seawater, it has become possible to consider a new definition of salinity based on conductivity. In October 1966, International Oceanographic Tables (UNESCO 1966) were published jointly by UNESCO and the National Institute of Oceanography in Great Britain. These Tables contain a new definition of salinity. In October 1967, the Tables, the definition of salinity, and the stated relationship between salinity and chlorinity were endorsed by IAPSO, which recommended that they be used by oceanographers and that all future oceanographic data reports include an explicit statement of the particular tables used in determining the values of the salinity reported. The conductivity method is now widely used in determining salinity, and the redefinition of salinity is required for its use. (Knapp-USGS)
W70-04318

MEASUREMENT OF ATMOSPHERIC PRESSURE AND SUBSURFACE-GAS PRESSURE IN THE UNSATURATED ZONE OF THE BANDELIER TUFF, LOS ALAMOS, NEW MEXICO,
Geological Survey, Santa Fe, N. Mex.
For primary bibliographic entry see Field 02G.
W70-04335

7B. Data Acquisition

SOIL MOISTURE - INSTRUMENTATION, MEASUREMENT AND GENERAL PRINCIPLES OF NETWORK DESIGN,
Guelph Univ. (Ontario). Dept. of Soil Science.
For primary bibliographic entry see Field 02G.
W70-04115

A DEVICE FOR DETERMINING SEDIMENTATION RATES IN RESERVOIRS,
Bureau of Sport Fisheries and Wildlife, Yankton, S. Dak. North Central Reservoir Investigations.
For primary bibliographic entry see Field 02J.
W70-04191

NEW METHODS OF PROBABILITY CALCULATIONS FOR DISCHARGES AND NON-SCOURING VELOCITIES IN RIVERS' CROSS-SECTIONS,
Institute of Building Technics, Warsaw (Poland).
For primary bibliographic entry see Field 02J.
W70-04255

INFLUENCE OF METHOD FOR REMOVAL OF SESTON ON THE DISSOLVED ORGANIC MATTER,
Washington Univ., St. Louis, Mo. Dept. of Botany.
Bruce C. Parker.
Journal of Phycology, Vol 3, No 4, p 166-173, 1967. 2 tab 20 ref.

Descriptors: *Analytical techniques, *Organic matter, *Seston, Water chemistry, Chemical analysis, Plankton, Filtration, Centrifugation, Dialysis, Scenedesmus, Adsorption, Activated carbon, Missouri, Eutrophication, Lakes, Water pollution effects, Dinoflagellates, Diatoms, Vitamin B, Phytoplankton.
Identifiers: *Organic solutes, Microcystis aeruginosa, Millipore filtration, Continuous-flow centrifugation, Biodialysis, Membrane filters, Scenedesmus quadricauda, Protosiphon botryoides, Paramecium bursaria, Westchester Lake (Mo), Beckman Infrared Carbon Analyzer, Ceratium, Peridinium, Synedra, Fragillaria, Coelastrum, Ankistrodesmus, Trachelomonas, Selas silver membranes, Whatman glassfiber filters, Vitamin B-12, Gelman Metricel filters.

Study of organic solutes in natural waters necessitates removal of seston (particulate organisms and detritus). Usual methods of sample treatment, including filtration and centrifugation, influence composition of water samples, but such problems are little studied and techniques are not standardized. Described are studies of some combinations of sample treatment and storage for laboratory cultures and naturally occurring samples which compare total dissolved carbon remaining after removal of seston. Results indicate that cellulose ester filters contain elutable carbon, removable with prewashing. Filtration to dryness may injure cells and release carbon to filtrates. Significant differences in retention exist between filters with pore sizes of 0.22 and 0.45 microns. Although both have limitations, most satisfactory methods were: wet filtration through prewashed Millipore filters (0.22 microns), and continuous flow centrifugation at 10,000-fold gravity and flow rate of 100 milliliters/minute. Ordinary centrifugation fails to remove some buoyant cells and may cause others to leak carbon. Evidence suggests that newly developed biodialysis technique may be more satisfactory than pre-existing methods. In this technique, a chamber, containing sterile distilled water retained between membrane filters, is placed in situ; dialysis of organic solutes from ambient water into chamber proceeds to equilibrium, while seston is excluded. (Eichhorn-Wisconsin)
W70-04285

ROTARY FLOW METER AS TURBULENCE TRANSDUCER,
Geological Survey, Fort Collins, Colo.
Erich J. Plate, and James P. Bennett.
ASCE Proceedings, Journal Engineering Mechanics Division, Vol 95, No EM6, Paper 6955, p 1307-1329, Dec 1969. 23 p, 10 fig, 13 ref, append.

Descriptors: *Flowmeters, *Turbulence, Instrumentation, Calibrations, Turbulent flow, Mathematical studies, Flow measurement, Gages, Stream gages.
Identifiers: Turbulence meters, Turbulence transducers.

Two factors prevent the direct determination of the point spectrum of axial turbulence from a spectrum of the fluctuations in rpm values of the analog output of a rotary flow meter. The first of these is the effect of the finite size of the flow meter propeller, the second is the effect of its inertia. The finite size effect depends on the local turbulence structure and is characterized by an 'efficiency factor' which in general can only be estimated. The effect of propeller inertia can be evaluated by linearizing the equation of motion of the propeller. From the resulting linear ordinary differential equation with constant coefficients, a transfer function for the linear system can be calculated. This transfer function makes it possible to calculate a spectrum of axial turbulence in which the velocity is averaged over the area of the propeller. Experiments in which propellers were oscillated sinusoidally while being towed through still water showed that the amplitude response function is approximately equal to that of a first-order system, while the phase function appeared to be independent of the natural frequency of the system. (Knapp-USGS)
W70-04308

DESCRIPTION OF A FREELY DROPPED INSTRUMENT FOR MEASURING CURRENT VELOCITY,
Nova Univ., Fort Lauderdale, Fla. Physical Oceanographic Lab.
William S. Richardson, Allan R. Carr, and Henry J. White.
Supported by Office of Naval Research. Journal of Marine Research, Vol 27, No 1, p 153-157, Jan 15, 1969. 5 p, 2 fig, 2 ref.

Descriptors: *Current meters, *Oceanography, *Currents (Water), *Ocean currents, Instrumentation, Flow measurement, Velocity, Drift bottles, Drifting (Aquatic).
Identifiers: Ocean current measurement.

A new form of freely dropped instrument for current-velocity measurements is described. Operational procedures for using the instrument and its auxiliary equipment are given. The instrument is dropped, a fix is taken, and the clock begins to count when the radio signal is lost as the transmitting antenna goes under water. When the instrument returns to the surface, the transmitter comes back on the air. The receiver hears this signal and turns off the clock, which then displays the run time. Since several simultaneous drops to different depths are often made and since each drop requires a back extrapolation from fix position to surfacing position, using the surface drift, a float is used to measure the surface current after the last instrument is dropped. The float has nearly the same dimensions as the instrument, but it is made to float like the instrument on the surface. (Knapp-USGS)
W70-04310

RESPONSE OF GAS-PURGED MANOMETERS TO WATER-LEVEL SURGES,
Geological Survey, Menlo Park, Calif.
J. R. Beck, and C. R. Goodwin.
Available from Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $3.75 per copy. Geological Survey Research 1969, Professional Paper 650-D, p D274-D277, 1969. 4 p, 3 fig.

Descriptors: *Water level fluctuations, *Steam gages, *Calibrations, *Manometers, Instrumentation, Water levels, Equipment, Laboratory tests, Waves (Water).
Identifiers: Gas-purged manometers, Bubble gages.

Tests were conducted to evaluate the performance of bubble-gage servocontrolled manometers when operating in a lake or stream whose water level is oscillating at amplitudes and frequencies that are likely to be found at medium or high stages in streams or in larger bodies of water subject to wind action. Results of the tests indicate that gas-purged manometers produce an accurate record of water stage under static conditions but indicate a stage value less than the mean of the surge when surface waves of significant amplitudes and frequencies are present. (Knapp-USGS)
W70-04337

DIFFUSION FROM A GASEOUS SOURCE IN A POROUS MEDIUM - A FIELD AND THEORETICAL COMPARISON,
Geological Survey, Idaho Falls, Idaho.
For primary bibliographic entry see Field 02F.
W70-04338

ANALOG COMPUTER MODELS FOR MOVEMENT OF NUCLIDES THROUGH ECOSYSTEMS,
Oak Ridge National Lab., Tenn. Health Physics Div.
For primary bibliographic entry see Field 05B.
W70-04380

ANALYTICAL CHEMISTRY OF PLANT NUTRIENTS,
Wisconsin Univ., Madison. Water Chemistry Lab.
For primary bibliographic entry see Field 05A.
W70-04382

APPLICATION OF A COMPUTER MODEL TO A DESERT WATERSHED,
Arizona Univ., Tucson. Dept. of Watershed Management.
For primary bibliographic entry see Field 02A.
W70-04397

7C. Evaluation, Processing and Publication

ELECTROMODELLING AS AN EFFECTIVE METHOD OF PROGNOSTICATING RESOURCES OF UNDERGROUND WATER DURING THEIR REPLENISHMENT,
U. S. Boot, U. I. Ljalko, and A. A. Falovsky.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (Mar 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 17-22, 1967. 6 p.

Descriptors: *Analog models, *Artificial recharge, *Alluvium, Streamflow, Groundwater movement, Discharge (Water), Resistance networks, Water yield, Infiltration, Groundwater basins.
Identifiers: *Severny Donetsk Valley (USSR).

Artificial and natural recharge of groundwater is predicted by an electric analog model of the Severny Donetsk Valley, USSR. Field hydrogeologic data and measured withdrawals are modeled and the results are used to optimize recharge programs. The model is constructed of electroconductive paper and copper wire. The aquifer modeled is an alluvial valley fill to be recharged with flood waters of the river. (Knapp-USGS)
W70-04128

COMPUTER MODEL OF CONNECTICUT RIVER POLLUTION,
United Aircraft Corp., East Hartford, Conn. Research Labs.
For primary bibliographic entry see Field 05B.
W70-04302

GROUNDWATER FLOW SIMULATED ON COMPUTER AIDS NUCLEAR PLANT RADIOACTIVE WASTE STUDY,
Battelle-Northwest, Richland, Wash. Water Resources Systems Section.
For primary bibliographic entry see Field 05B.
W70-04309

FLOOD OF AUGUST 1969, RICHMOND QUADRANGLE, RICHMOND, VIRGINIA,
Geological Survey, Washington, D.C.
E. M. Miller.
Available from U S Geological Survey, Washington, DC, 20240, for $0.75 per copy. Geological Survey Hydrologic Investigations Atlas HA-410, 1 sheet, 1969. Text, 2 fig, 2 photo, 1 map, 1 tab.

Descriptors: *Floods, *Virginia, *Hurricanes, *Historic flood, Cloudbursts, Peak discharge, Rain, Rain water, River flow, Storm runoff, Stage-discharge relations.
Identifiers: James River (Va), Richmond (Va).

The approximate areas inundated in and near Richmond, Va., by the flood of August 22, 1969, on the James River are shown on a topographic map. The flood was caused by torrential rains brought by the remnants of Hurricane Camille. The flood of May 1771 is considered the greatest in the James River basin since the settlement of Jamestown in 1607. The August 1969 flood at the Virginia Division of Water Resources gaging station, 0.1 mile upstream from the Huguenot Memorial Bridge (river mile 111.7), reached a stage of 24.95 feet, gage datum, (discharge, 222,000-cfs) and was the highest for the period of record (1935-69). At the U.S. Weather Bureau gaging station at river mile 103.7, the flood reached a stage of 28.6 feet, msl, (29.9 ft at former site of U.S. Weather Bureau gaging station at river mile 104.6), and was the highest since the great flood of 1771. (Knapp-USGS)
W70-04348

FLOOD OF AUGUST 1969 ON MAURY RIVER AT BUENA VISTA, VIRGINIA,
Geological Survey, Washington, D.C.
Gerald S. Runner.
Available from U S Geological Survey, Washington, DC, 20240, for $0.50 per copy. Geological Survey Hydrologic Investigations Atlas HA-412, 1 sheet, 1969. Text, 2 fig, 3 photo.

Descriptors: *Floods, *Virginia, *Hurricanes, *Historic flood, Cloudbursts, Peak discharge, Rain, Rain water, River flow, Storm runoff, Stage-discharge relations.
Identifiers: Maury River (Va), Buena Vista (Va).

The approximate area inundated by the Maury River at Buena Vista, Va., during the flood of August 20, 1969, is shown on a photomosaic base map and photographs. The flood, the highest known on the river, was caused by the torrential rains brought by the remnants of Hurricane Camille. Floodmarks were identified in a 4-mile reach of the river near Buena Vista, and their elevations were determined by leveling to bench marks. Flood boundaries were delineated on aerial photographs taken after the crest and were verified by field inspection. The flood of August 20, 1969, reached an elevation of 852.0 ft above mean sea level (msl) at U.S. Highway 60 at Buena Vista and was the highest since records began in 1936 and probably the highest since 1870. The previous maximum of record was 845.8 ft, msl, at the same site during the flood of March 17-19, 1936. Stage-frequency relations were derived from stage records for the U.S. Weather Bureau gage at U.S. Highway 60 at Buena Vista for the period 1936-69. Profiles of the water surface constructed from high-water marks left by the flood are given. (Knapp-USGS)
W70-04349

FLOOD OF AUGUST 1969, DREWRYS BLUFF QUADRANGLE, RICHMOND, VIRGINIA,
Geological Survey, Washington, D.C.
E. M. Miller.
Available from US Geological Survey, Washington, DC, 20240, for $0.75 per copy. Geological Survey Hydrologic Investigations Atlas HA-411, 1 sheet, 1969. Text, 2 fig, 1 photo, 1 map, 1 tab.

Descriptors: *Floods, *Virginia, *Hurricanes, *Historic flood, Cloudbursts, Peak discharge, Rain, Rain water, River flow, Storm runoff, Stage-discharge relations.
Identifiers: James River (Va), Richmond (Va), Flood frequencies.

The approximate areas inundated in and near Richmond, Va., by the flood of August 22, 1969, on the James River are shown on a topographic map. The flood was caused by torrential rains brought by the remnants of Hurricane Camille. The flood of May 1771 is considered the greatest in the James River basin since the settlement of Jamestown in 1607. The August 1969 flood at the Virginia Division of Water Resources gaging station, 0.1 mile upstream from the Huguenot Memorial Bridge (river mile 111.7), reached a stage of 24.95 feet, gage datum, (discharge, 222,000 cfs) and was the highest for the period of record (1935-69). At the U.S. Weather Bureau gaging station at river mile 103.7, the flood reached a stage of 28.6 feet, msl, (29.9 ft at former site of U.S. Weather Bureau gaging station at river mile 104.6), and was the highest since the great flood of 1771. The relationship between recurrence interval and elevation above mean sea level at the gaging station on the James River near Richmond (river mile 111.7) is shown graphically. (Knapp-USGS)
W70-04350

08. ENGINEERING WORKS

8A. Structures

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN ARIZONA.
Corps of Engineers, San Francisco, Calif. South Pacific Div.
For primary bibliographic entry see Field 04A
W70-04387

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN CALIFORNIA.
Corps of Engineers, San Francisco, Calif. South Pacific Div
For primary bibliographic entry see Field 04A.
W70-04388

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN UTAH.
Corps of Engineers, San Francisco, Calif. South Pacific Div.
For primary bibliographic entry see Field 04A.
W70-04393

WATER RESOURCES DEVELOPMENT BY THE U.S. ARMY CORPS OF ENGINEERS IN NEVADA.
Corps of Engineers, San Francisco, Calif. South Pacific Div.
For primary bibliographic entry see Field 04A.
W70-04394

'ONE HUNDRED AND TWENTY-THREE FEET LONG': THE HORIZONTAL WELL AS A NEW METHOD OF RANGE WATER DEVELOPMENT,
Arizona Univ., Tucson. Cooperative Extension Service.
For primary bibliographic entry see Field 04B.
W70-04396

A WORLD GEOGRAPHY OF IRRIGATION,
For primary bibliographic entry see Field 03F.
W70-04404

CHICAGO'S SOUTH DISTRICT FILTRATION PLANT.
Department of Water and Sewers, Chicago, Ill.
For primary bibliographic entry see Field 05F.
W70-04437

THE CHICAGO SEWER SYSTEM, 100 YEARS OF PROTECTING CHICAGO'S HEALTH,
Department of Water and Sewers, Chicago, Ill.
T. S. Ford, and James Moorman.
Chicago, City of Chicago Department of Water and Sewers, 1956. 22 p, 1 fig, 44 photos.

Descriptors: *Sewers, *Drainage systems, *Sewage, *Storm drains, *Closed conduits, *Channels, *History, Public health, Drainage water, Pipes, Construction, Tunneling, Canals construction, Waste water treatment, Pumping plants, Diseases.
Identifiers: *Chicago, *Chicago Department of Water and Sewers, *Chicago Sanitary District, Interceptor sewers, Sewer construction, Sewer history, Chicago sewer system.

This historical work summarizes the first 100 years of Chicago's city sewer system. A plan for a sewer system was adopted by the Board of Sewerage Commissioners in 1855. The sewers were designed to discharge into Lake Michigan and the Chicago

River. The 'combined' sewers were to be constructed of brick masonry and tile pipe. During 1856, sewers in the present 'Loop' district were built. By 1861, the system included 54 miles of sewers with 2,400 house connections. By 1886, the Chicago River had become a putrid septic tank from sewage discharges, and epidemics were prevalent. The state legislature passed an enabling act and, in 1889, the Sanitary District of Chicago was formed to dig a canal to flush Chicago's sewage to the Mississippi River, via the Fox and Illinois Rivers. The Sanitary and Ship Canal, was completed in 1900. In 1910, the North Shore Channel was completed, and intercepting sewers and two pumping stations were built near the Lake. The Calumet Sag Canal was completed in 1923. Sewage treatment plant construction was begun in 1922. By 1956, Chicago's sewer system included in 3,600 miles of sewers with 450,000 connections, 132,000 manholes and 190,000 catch basins. Its replacement cost was valued at $500 million. (Poertner-Chicago)
W70-04438

CHAPTER 2: DESCRIPTION.
Department of Public Works, Chicago, Ill.
For primary bibliographic entry see Field 04C.
W70-04440

CHAPTER 4: CONSTRUCTION.
Department of Public Works, Chicago, Ill.
For primary bibliographic entry see Field 04C.
W70-04441

8B. Hydraulics

STABILIZATION OF ALLUVIAL CHANNELS,
Colorado State Univ., Fort Collins. Natural Resources Center.
N. G. Bhowmik, and D. B. Simons.
Available from the Clearinghouse as PB-189 768, $3.00 in paper copy, $0.65 in microfiche. Colorado State Univ, Natural Resources Center, Partial Completion Report, June 30, 1969. 50 p. OWRR Project A-002-COLO.

Descriptors: *Channel stabilization, *Design hydraulic, Alluvial, Bends, Boundary shear, Mechanics, Riprap, Stability, Waves.

Flow dynamics and the effects of turbulent fluctuations of velocity, drag forces, lift forces, waves and secondary circulations on the stability of riprap particles forming the perimeter of stable alluvial channels were studied. A field study was made of three channels successfully stabilized with gravel riprap. Additional available existing data on initiation of motion and on stable channels formed in coarse materials were gathered and analyzed to explain the flow dynamics and to outline a design procedure for canal stabilization. Necessary relationships were developed to facilitate the design of stable channels formed in coarse alluvial materials. A design procedure valid for both the straight reaches and the bends to stabilize alluvial channels is presented.
W70-04050

BOUNDARY EFFECTS ON JET FLOW PATTERNS RELATED TO WATER QUALITY AND POLLUTION PROBLEMS,
Illinois Univ., Urbana. Dept. of Civil Engineering.
W. Hall C. Maxwell, and Hormoz Pazwash.
Available from the Clearinghouse as PB-189 787, $3.00 in paper copy, $0.65 in microfiche. Completion Report, Illinois Water Resources Center, Research Report No 28, Jan 1970. 84 p, 3 tab, 28 fig, 20 ref. OWRR Project B-017-ILL.

Descriptors: *Boundaries (Surfaces), *Diffusion, Flow characteristics, *Flow profiles, *Free surfaces, Hydraulics, *Jets, Temperature, Tracers.
Identifiers: Fluid flow, Free turbulence, Heat flux, Mass flux, Momentum flux, Similarities.

An experimental and analytical study of the modification of jet flow patterns by a nearby free surface and nearby horizontal or gently downward sloping plane bed is described. The patterns were found to be radically different from those for a deeply submerged jet. Both the free surface and bed tend to attract the jet and both cause spreading of the flow in their proximity. One boundary generally proves to be dominant, depending upon the geometrical parameters. The analytic study used Reichardt's hypothesis and its generalization for momentum, mass and heat flux by Alexander, Baron and Comings. The techniques are first applied to predict the effect of finite nozzle size on deeply submerged jet flows. Then the effect of the free surface on a shallow submerged jet is studied. A strong influence by a small initial upward deflection of the jet is indicated. A preliminary suggestion is made for a mathematical model to represent a shallow submerged jet in a shallow reservoir. The results may be applied in the study or design of discharge outlets, syphon spillways, hydraulic breakwaters and diffusion of tracers in streams. The diffusion of momentum, mass or heat may be studied using the analytic techniques.
W70-04068

HYDRAULIC RESISTANCE IN ALLUVIAL CHANNELS,
Illinois Univ., Urbana. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02J.
W70-04070

THE MECHANICS OF A DROP AFTER STRIKING A STAGNANT WATER LAYER,
Illinois Univ., Urbana. Dept. of Civil Engineering.
Harry G. Wenzel, Jr., and Raymond C. T. Wang.
Available from the Clearinghouse as PB-189 790, $3.00 in paper copy, $0.65 in microfiche. Completion Report, Illinois Water Resources Center, Research Report No 30, Jan 1970. 130 p, 3 tab, 4 fig, 147 ref, 4 append. OWRR Project B-018-ILL.

Descriptors: *Impact (Rainfall), *Numerical analysis, *Raindrops, Shear stress, *Sheet flow, Soil erosion, Resistance.

A first step is represented in the theoretical analysis of sheet flow with rainfall impinging on the free surface. This is a common occurrance in urban areas and many design procedures do not recognize the added resistance due to the rainfall. The analytical approach consists of the numerical solution of the Navier-Stokes equations, including surface tension as a boundary condition, using a Synthetic-Cell-Fluid scheme which rigorously conserves mass and momentum. The results include a maximum impact pressure model and a quantitative discussion of pressure distribution, boundary shear, the effect of surface tension, the free surface configuration, and the various forms of energy and its transformation during the impact process. Experiments were performed consisting of drop impact pressure measurements using various drop sizes, impact velocities and water layer depths. These data were used to successfully verify the theoretical work.
W70-04071

MODEL AND PROTOTYPE TESTS OF BUOYANT SPILLWAY GATES,
Pacific Gas and Electric Co., San Francisco, Calif.
Arthur G. Strassburger, and James F. Sias.
Proc Amer Soc Civ Eng, J Power Div, Vol 95, No PO2, p 335-349, Oct 1969. 15 p, 17 fig.

Descriptors: *Radial gates, *Spillway gates, Hydraulic gates, Models, *Model tests, *Prototype tests, Earth dams, Buoyancy, Floods, Floats, Hydraulic models, Water levels, Safety, Reservoir operation, Leakage, Design criteria Spillways, Gate control, Gate seals, Gate seats.
Identifiers: *Test results, McCloud Dam (Calif).

Design of a radial gate, modified to obtain an opening torque, and having an additional upstream projection to obtain buoyancy for fail-safe operation, is presented. Operating requirements for a full reservoir during winter storm periods precluded an uncontrolled spillway or gates held open. An earth and rockfill dam, on the contrary, required fail-safe spillway control. A difficult site added to the design and cost problems. The gate as designed can open to pass in excess of the record flood without external power source or without float wells, tripping devices, counterweights, or other accessories. Model tests were conducted for determining downpull effects of flow under a gate and through adjacent gates. Prototype tests under operating conditions were conducted; results are compared with model test results. Adjustable side plates replace conventional seals to eliminate seal friction and keep leakage to a tolerable limit.
W70-04264

MECHANICS OF FLOW IN OPEN CHANNEL SYSTEMS,
California Univ., Davis. Dept. of Water Science and Engineering.
J. Amorocho, and Alan Babb.
Available from the Clearinghouse as PB-189 954, $3.00 in paper copy, $0.65 in microfiche. California University Water Science and Engineering Paper No 1040, Nov 1969. 10 p, 7 ref. OWRR Grant No B-037-CAL. Grant W113 Univ of Calif.

Descriptors: *Open channel flow, *Hydraulics, *Junctions, *Radial gates, Hydraulic transients, Roughness (Hydraulic), Hydraulic similitude, Model studies, Hydraulic models, Channel morphology, Hydraulic structures, Gates.
Identifiers: Channel transitions, Hydraulic transitions.

Flow phenomena in channel transitions and flow in the neighborhood of open channel gates and controls were studied in laboratory channels. Data were obtained on the variation of the energy losses for warped expansions at high Reynolds' numbers and criteria were established for corrections of incomplete similitude in model investigations of these configurations. Detailed analyses of the fluid mechanics of expansions were advanced with the study of conical shapes. These investigations involved the development of special laboratory techniques and the evaluation of the terms of the integrated equations of energy and momentum balance for the flow in the expanding fields. The analysis of the results will lead to analytic methods for optimum transition design. The behavior of radial gates under a large variety of flow conditions was investigated with particular reference to multigated structures. (Knapp-USGS)
W70-04296

ROTARY FLOW METER AS TURBULENCE TRANSDUCER,
Geological Survey, Fort Collins, Colo.
For primary bibliographic entry see Field 07B.
W70-04308

THE INTERACTION OF INTERNAL WAVES WITH AN UNSTEADY NON-UNIFORM CURRENT,
Johns Hopkins Univ., Baltimore, Md. Dept. of Mechanics.
For primary bibliographic entry see Field 02E.
W70-04326

SIMILAR SOLUTIONS OF TURBULENT BOUNDARY LAYER HEAT AND MASS TRANSFER PROBLEMS,
Rensselaer Polytechnic Inst., Troy, N.Y. Dept. of Chemical Engineering.
L. F. Donovan, O. T. Hanna, and S. Yerazunis.
Chemical Engineering Science, 1967, Vol. 22, p. 595-610, Pergamon Press.

Descriptors: *Heat, *Heat transfer, *Temperature, Mass transfer, *Turbulent boundary layers, Momentum equation, Turbulence, Thermodynamic behavior, Heat Balance, Shear, Viscosity, Eddies.

It is shown that similar solutions of certain turbulent boundary layer heat and mass transfer problems can be obtained when the thermal and diffusion layers lie within the constant shear layer, as is the case when Prandtl and Schmidt numbers are large. Closed form solutions are obtained for the problems of heat transfer from an isothermal surface, mass transfer with a finite interfacial velocity, and heat transfer from a surface having a particular temperature distribution. A comparison of experimental duct heat transfer data with Spalding function calculated with each of Spalding's laws of the wall shows that one of the laws is significantly superior to the other. (Novotny-Vanderbilt)
W70-04472

TRANSPIRATIONAL HEAT TRANSFER FROM A CYLINDER IN CROSS FLOW INCLUDING THE EFFECTS OF TURBULENT INTENSITY,
Oregon State Univ., Corvallis.
Eugene Elzy, and C. E. Wicks.
Heat transfer-Seattle, Chemical Engineering Progress, Symposium series, Vol. 64, No. 82, 1968, p 150-165.

Descriptors: *Heat transfer, *Reynolds number, *Turbulent flow, Cooling, Mass transfer, Momentum transfer, Boundary layer, Transpiration, Laminar flow, Air, Heat exchangers, Friction, Winds.
Identifiers: *Heat transfer coefficient, Wind tunnel, Air injection.

The local heat transfer coefficient is measured in the laminar and separated regions of a cylinder in cross-flow mounted in a subsonic wind tunnel. Experiments are conducted by uniformly injecting hot air from the porous cylindrical surface. The effects of Reynolds number and turbulent intensity of the mainstream air is studied at various injection rates. The local heat transfer coefficient is decreased by injection in all regions around the cylinder at both low and high turbulent intensities. The experimental results for low turbulence are compared with theoretical predictions by the Eckert and Merk similar methods for the laminar region, and good agreement is obtained. (Novotny-Vanderbilt)
W70-04477

FORCE ON A SMALL SPHERICAL EVAPORATING PARTICLE IN ITS PURE VAPOUR DUE TO MOTION AND TEMPERATURE GRADIENTS,
Central Electricity Generating Board, Leatherhead (England). Central Electricity Research Labs.
G. C. Gardner.
Chemical Engineering Science, Vol. 23, p. 29-40, 1968. 2 fig., 16 ref.

Descriptors: *Evaporation, *Energy transfer, Viscosity, Stress, Temperature, *Velocity, *Temperature distribution, Reynolds number, Equilibrium, Latent heat, Vapor pressure.
Identifiers: *Slip.

Analyses are made for the free molecular regime, where the particle is small compared to the mean free path of vapor molecules, and for the viscous continuum-slip regime, where the particle is large compared to the mean free path. Energy exchange between the vapor and the particle is considered in the free molecular regime as well as the momentum exchange, which has previously been considered for inert, non-evaporating particles. Thus, it is shown that conduction of heat within the particle can have a small importance for the larger particles that are included within the regime. Otherwise the equations for the force on a particle reduce to particular forms of those already derived for inert particles. The equations for the continuum regime, without slip, show that the particle has an equilibrium velocity equal to the velocity that the continuum would attain, if the heat being conducted far from the particle, due to the temperature gradient, was used to evaporate more vapor and thus create a vapor flow. When, however, the particle size becomes small enough for slip to be important, the equilibrium velocity rises above this value. (Novotny-Vanderbilt)
W70-04480

SURFACE RESISTANCE IN TRANSPORT FROM VAPOR TO LIQUID,
Lehigh Univ., Bethlehem, Pa. Whitaker Lab.
Robert W. Coughlin.
Chemical Engineering Science, Vol. 22, p. 1503-1511, 1967. 3 fig., 19 ref.

Descriptors: *Condensation, *Diffusion, Eddies, Jets, *Distribution, Mass transfer, Thermal conductivity, Thermodynamic behavior, Temperature.

The role of surface resistance in the formulation of the penetration theory of interphase transfer is examined for the cases of constant, uniform surface renewal rate and random surface renewal; using the distribution function proposed by Danckwerts, it is shown that both cases are almost equivalent. Some recent data obtained in experiments aimed at measuring the condensation coefficient of water are examined in light of penetration theory formulated with and without surface resistance. It is shown that the data suggest a transition from the conventional penetration theory (without surface resistance) to a regime where surface resistance becomes important and begins to control the transport rate. It is also pointed out that the data may suffer from fluid mechanical acceleration effects and that they also suggest a condensation coefficient which decreases with time. (Novotny-Vanderbilt)
W70-04485

EXACT SOLUTION TO ENTRY-REGION LAMINAR HEAT TRANSFER WITH AXIAL CONDUCTION AND THE BOUNDARY CONDITION OF THE THIRD KIND,
Brookhaven National Lab., Upton, N.Y.
Hsu Chia-Jung.
Chemical Engineering Science, Vol. 23, p. 457-468, 1968. 4 tabs, 7 figs, 6 refs.

Descriptors: *Heat transfer, *Laminar flow, Mass transfer, Temperature, Viscosity, Reynolds number, *Mathematical models, Energy, *Heat flow, Diffusion, Bulk density, Specific heat, Velocity.

A mathematical scheme is devised for obtaining the exact thermal-entry-region temperature solutions for laminar flow (Poiseuille's parabolic velocity profiles) heat transfer subject to significant axial conduction and the boundary condition of the third kind. It is demonstrated that the heat transfer problem which ignores the effect of axial conduction, in reality, corresponds to a part of the generalized problem in which such effect is taken into consideration. Irrespective of the significance of axial conduction, the temperature solution can be represented by a unique mathematical expression in which only the magnitude of the eigenvalues and the associated constants vary with Peclet number. As Peclet number approaches infinity, the generalized temperature solution reduces to that for the case of negligible axial conduction. Determination of the first twelve eigenvalues, eigenfunctions and the series expansion coefficients was made with the aid of high-speed digital computer, for Peclet numbers of 1, 5, 10, 20, 30, 50, 100 and infinity, and for convective parameter delta (%kr sub zero/k) of 2, 10 and 100. Examination of the thermal-entry-region temperature profiles and the local Nusselt numbers revealed that the effect of axial conduction is indeed significant if Peclet number is less than approx. 100. The results of the present analysis showed good qualitative agreements with those of Schneider, who analyzed a similar problem by assuming a slug-flow model. (Novotny-Vanderbilt)
W70-04486

THE STABILITY OF BLOCKS SUBJECTED TO PLUNGING WATER JETS,
Windsor Univ. (Ontario).
S. P. Chee, and P. V. Padiyar.
Water Resour Bull, Vol 5, No 3, p 57-62, Sept, 1969. 6 p, 3 fig, 8 ref.

Descriptors: *Energy dissipation, Flip buckets, *Spillways, *Scour, Baffles, *Riprap, River beds, Streambeds, Jets, *Stilling basins, Model tests, Hydraulic models, Erosion, Hydraulics, Hydraulic structures, Foreign research.
Identifiers: *Energy dissipators, *Plunge basins, Foreign testing, *Armoring (Streambed), Ontario (Canada), Canada.

The energy of a jet of water from a spillway is commonly dissipated by using flip buckets to throw the jet a safe distance from the spillway. Model tests are often made to evaluate scouring in a homogeneous bed of granular material; the results always show a regular dish-shaped hole. The adverse performance of some prototype buckets has cast coubts on the wisdom of this design philosophy. Natural riverbeds are heterogeneous and develop very irregular steep-sided scour holes that may progress upstream and endanger the spillway. Secondary currents generated in the irregularly shaped scour hole break up and undermine the riverbed. Eliminating the secondary currents would protect the scour hole from further deterioration. This could be achieved by excavating a plunge pool and protecting the hole by armoring the bed with a layer of large boulders. Laboratory tests were made on the stability of cubical blocks subjected to plunging water jets. The blocks were placed in a plunge basin at the base of a flip bucket. A dimensionless equation was derived and a nomogram was drawn to facilitate the solution. The results can be applied in determining the size of stones required to armor a plunge basin or scour hole. (USBR)
W70-04540

8C. Hydraulic Machinery

WHAT ARE THE PROSPECTS FOR HV AND EHV UNDERGROUND TRANSMISSION SYSTEMS,
Sargent and Lundy, Chicago, Ill.
E. H. Finch.
Consult Eng, Vol 33, No 3, p 128-136, Sept 1969. 7 p, 5 tab, 3 ref.

Descriptors: *Transmission (Electrical), *Extra high voltage, Costs, Research and development, *Electric cables, *Underground, Technology, Transmission lines, Trenches, Comparative costs, Thermal properties, Dielectrics, Reliability, Failure (Power), Maintenance, Electrical equipment, Electrical design, Aesthetics, Economics, Electric insulation.
Identifiers: *High voltage, *Underground cables, Power losses, Federal Power Commission, Pipe-type cables, Dielectric properties, Outages.

A major technological breakthrough is necessary before ehv underground transmission systems can be justified economically. Although the cost differential is less for hv lines, the difference is still staggering compared to overhead lines. The solution may be to develop an entirely new type of underground system. Cost comparisons are given for underground versus overhead transmission systems for 138 kv and 345 kv. Technical problems presented in underground installations are discussed. Current research and details of several major research projects are reviewed. Placing ehv underground is discouraging from economic and technical factors inherent in today's designs, but the large volume of research is encouraging. A major breakthrough may be made because of the existing need.
W70-04136

ELECTRICAL STRESS IN OIL-FILLED AND SOLID-TYPE HIGH VOLTAGE DIRECT CURRENT CABLES UNDER THERMAL AND ELECTRICAL TRANSIENT CONDITIONS,
Sumitomo Electric Industries Ltd., Osaka (Japan).
K. Kojima, and K. Matsuura.

Direct Curr, Vol 1, No 2, p 55-72, Aug 1969. 18 p, 35 fig, 5 tab, 7 ref.

Descriptors: *Electric cables, *Direct current, Electrical studies, Stress, *Stress distribution, Electric insulation, *Transient stress, Electric potential, Resistivity, Temperature, Polarity, Instrumentation, Experimental data, Foreign research, Thermal stress, Time, Dielectrics, Electric currents, Electric fields.
Identifiers: *Oil-filled cables, Japan, *High voltage, Cable sheaths, Potential gradients, Temperature rise, Electric conductors, Test results.

Many complicated effects concerning the insulation design of paper-insulated, oil-filled and solid-type, high-voltage direct-current (hvdc) cables are clarified. The purpose is achieved by tests performed under different thermal and electrical transient conditions. Measuring potentials and stresses in the insulation in each case provided much information for the discussion on stress distributions in insulation at no-load conditions, at thermal transient conditions, and at rapid polarity reversal. In the cases of oil-filled cables, experimental results show fairly good agreement with theoretical distribution calculations, based on the characteristics of resistivity-temperature and stress observed on impregnated paper-insulated cables. The experimental arrangement for measuring potential distribution throughout the solid cable insulation is described. Results are given, and comparisons are made between measured values of potential distribution and theoretical values.
W70-04139

TOWER DESIGNS FOR AEP 765-KV PROJECT,
American Electric Power Service Corp., New York.
Richard A. Kravitz, and A. James Samuelson.
Proc Amer Soc Civ Eng, J Power Div, Vol 95, No PO2, p 305-319, Oct 1969. 15 p, 5 fig, 4 tab, 4 ref, 2 append.

Descriptors: *Structural design, Structural engineering, Transmission lines, *Transmission towers, *Extra high voltage, Spans, Loads (Forces), Winds, Guyed towers, Design, Overhead ground wire, Torsion, Foundations, Testing, Design criteria, Yield strength, Computer programs.
Identifiers: Tower height, *Test results, Allowable stress, Anchored footings, Comparative studies.

Designs of 765-kv transmission line towers used by the American Electric Power Co (AEP) are summarized. The weather loading conditions and line design criteria used in developing structure configuration and designs are described. Tower designers and engineers responsible for developing design specifications are alerted to the pitfalls of designing towers without considering all practical combinations (within a loading combination) of some minimum with maximum loads and unequal leg extension combinations in rough terrain. The AEP computer program for analyzing towers as 3-dimensional elastic structures is discussed and comparisons are made to hand (static) methods used for analyzing towers. Alternate types of foundations to be used are described, insofar as anchor movement affects structure capabilities.
W70-04265

DELAWARE RIVER BASIN COMPACT (WATERSHEDS, RECREATION, HYDROELECTRIC POWER, FINANCING, GENERAL PROVISIONS).
For primary bibliographic entry see Field 06B.
W70-04361

SOLAR BATTERIES AND AGROECONOMY OF DEVELOPING NATIONS,
Jadavpur Univ., Calcutta (India). Dept. of Electronics and Telecommunication Engineering.
For primary bibliographic entry see Field 03F.
W70-04413

8D. Soil Mechanics

STABILITY OF SLOPES WITH SEEPAGE,
Colorado State Univ., Fort Collins. Natural Resources Center.
C. D. Muir, and D. B. Simons.
Available from the Clearinghouse as PB-189 770, $3.00 in paper copy, $0.65 in michrofiche. Colorado State Univ, Natural Resources Center, Partial Completion Report, June 30, 1969. 30 p, 1 ref. OWRR Project A-002-COLO.

Descriptors: *Bank stability, *Slope stability, Seepage, Hydraulic design, Slip circle, Embankments.

The effect of steady seepage on slope stability was based on laboratory tests on embankments having slopes of 2 to 1, 3 to 1, 4 to 1, and 5 to 1, and including sections with gravel toe, coarse central layer, coarse layer parallel to the surface, fine cnetral layer, and alternating fine and coarse layers. Computed stability numbers gave an indication of the change in location of the failure zone, as well as giving the cohesion values required for slope stability for friction angles of 5, 10, and 20 degrees and for 0, 40, and 100 percent saturation above the phreatic surface. Graphic correlations in three variables are presented by plotting stability numbers and the pore pressure parameter, Ru sub ave. versus ratios of headwater and tailwater to embankment height. The possible contribution of tailwater to both surface and massive circular slope failures is clearly indicated. Also, an explanation of the shape of surface sloughing based on pore pressure distribution is presented.
W70-04052

OPTIMUM PRELOAD RATES FOR COMPRESSIBLE NORMALLY CONSOLIDATED SOILS,
Northwestern Univ., Evanston, Ill; and Howard Univ., Washington, D.C.
Raymond J. Krizek, Clarence H. C. James, and Jorj O. Osterberg.
Soils Found, Vol 9, No 3, p 58-81, Sept 1969. 24 p, 7 fig, 4 tab, 28 ref.

Descriptors: *Loading rate, Loading time, *Consolidation, Computer programs, Shear strength, Bibliographies, Bearing capacities, Numerical analysis, *Foundations, Soil engineering, Soil mechanics, Soil strength, Settlement (Structural), Theory, Soil properties, Pore pressure.
Identifiers: Optimum loading, *Compressible soils, *Compressible foundation, *Preloading.

The significance of shear strength increases on allowable preload rates for compressible, normally consolidated soils subjected to a flexible strip load is examined. On the basis of representative soil parameters and various assumed boundary conditions, a computer analysis was made to predict systematically rates and magnitudes of shear strength increases and associated settlements occurring as primary consolidation progresses, and to evaluate the bearing capacity of the soil in terms of the strength increases. With adequate drainage, weak soils may increase measurably in bearing capacity during consolidation in a time period compatible with many construction schedules. Inadequate drainage precludes any reasonable bearing capacity increase, except when the ratio of horizontal to vertical coefficient of consolidation is large. Consolidation settlement is governed by the magnitude and duration of the applied load, which is governed, in turn, by the rate of bearing capacity increase. Consolidation settlements can be accelerated to a worthwhile degree only when reasonable bearing capacity increases occur. Optimizing preload rate is of little benefit if initial soil strength is high. (USBR)
W70-04262

EFFECT OF WATER CONTENT ON THE SHEAR CHARACTERISTICS OF GRANULAR SOILS SUCH AS SHIRASU,
Kagoshima Univ. (Japan).
Motohisa Haruyama.
Soils Found, Vol 9, No 3, p 35-37, Sept 1969. 23 p, 18 fig, 3 photo, 1 tab, 22 ref.

Descriptors: *Moisture content, Effects, Shear strength, Granular materials, Shear tests, Characteristics, *Sands, Triaxial compression, *Triaxial shear, Cohesion, Internal friction, Void ratio, Stress-strain, Curves, Axial strain, Foreign research, *Soil mechanics, Bibliographies, Soil properties, Shear stress.
Identifiers: Water content, Triaxial tests, Drained tests, *Soil characteristics, Japan, Rowe equation.

The effect of water content on shearing characteristics of granular soils such as Shirasu (white volcanic sand) is examined by drained triaxial compression tests on compacted specimens having different water contents. Axial strain at failure and dilatancy decreases as the water content increases. Decrease in dilatancy causes decrease in critical void ratio. Parameters of shear strength vary with confining pressure; the frictional component is large at lower pressures and the cohesion component is large at higher pressures. Particle interlocking causes the failure envelopes to be curved and have a cohesion intercept. At relative densities above 70% and water contents below 10% the angle of shearing resistance does not vary with water content; at other densities and water contents, the angle of shearing resistance decreases as the water content increases. Apparent cohesion at all densities is highest at water contents of 10 to 20% and decreases considerably at water contents above 10 to 20%. Decrease in shear strength with increase in water content is caused by a decrease in the portion of strength contributed by particle interlocking.
W70-04263

MIXING-IN-PLACE SOIL AND PORTLAND CEMENT.

Proc Amer Soc Civ Eng, Soil Mech Found Div, Vol 95, No SM6, p 1357-1363, Nov 1969. 7 p, 12 ref, append.

Descriptors: Construction costs, Cement grouts, *Foundations, Portland cements, *Soil cement, *Soil stabilization, Underground structures, Soil mechanics, Costs, Piles (Foundations), Mixing.
Identifiers: Construction methods.

Practical methods can be developed for mixing natural soils in place with cement grout to obtain reasonably uniform and strong soil-cement concrete to depths of 50 to 75 ft at rates of 50 to 100 cu yd/hr and at a cost of about $10/cu yd. Mixing-in-place methods will have widespread application, particularly for constructing underground walls and masses of soil-cement concrete for structure foundations in earthquake regions. Uses of plastic soil-cement are discussed and methods of mixing soil and cement in place below the ground surface are summarized. (USBR)
W70-04530

SAND DENSIFICATION BY PILES AND VIBROFLOTATION,
Woodward-Clyde-Sherard and Associates, Oakland, Calif.; and Naval Facilities Engineering Command, San Bruno, Calif. Western Div.
Carl E. Basore, and Joseph D. Boitano.
Proc Amer Soc Civ Eng, J Soil Mech Found Div, Vol 95, No SM6, pp 1303-1323, Nov, 1969. 21 p, 22 fig, 1 tab, 7 ref, append.

Descriptors: Compaction tests, Compaction, Compaction equipment, Cohesionless soils, *Foundations, Field tests, Liquefaction, Sands, Penetration resistance, Penetration tests, Piles (Foundations), Soil engineering, Soil liquefaction, Soil mechanics, Test procedures, Loose soils, *Soil compaction.

Identifiers: Comparative studies, Construction methods, Procedures, *Vibroflotation, *Compaction piles, *Vibratory compaction.

The effectiveness of compaction piles and vibroflotation in densifying 30 ft of loose to medium-dense sandfill at Treasure Island, Calif, was evaluated by field tests. Compaction piles were formed by driving a 14-in.-dia steel pipe mandrel with a false bottom to the required depth, filling the pipe with sand, and then withdrawing the pipe to leave a sand column. Relative densities of the fill were measured before and after densification by standard penetration tests and with samples obtained using a piston sampler. Compaction piles and vibroflotation were effective in densigying the sandfill when proper spacing was used. Vibroflotation produced a more uniformly dense fill. Compaction piles were spaced closer together than vibroflot points to produce the same relative density. Limited cost data indicate that vibroflotation is more economical than compaction by piles. (USBR)
W70-04533

A FLEXIBLE PROGRAM FOR AUTOMATIC ANALYSIS OF STABILITY OF SLOPES,
Mozambique Univ., Lourenco Marques; and Laboratorio Nacional de Engenharia Civil, Lisbon (Portugal).
J. B. Martins, E. Maranha, and F. A. Melo.
Eng Geol, Vol 3, No 3, p 249-261, July, 1969. 13 p, 6 fig, 3 tab, 10 ref.

Descriptors: *Computer programs, *Slip-circle method, Soil mechanics, *Slope stability, Soil engineering, Soil strength, *Stability analysis, Safety factors, Pore pressure, Earth dams, Embankments, Equations, Flow diagrams, Fills, Earthworks, Soil stability, Foreign design practices.
Identifiers: Computer-aided design, Bishop method of slices, Piezometric surface, Portugal.

A computer program for stability analysis of slopes (land slopes, earth dams, embankments, and quay walls) by the Swedish slip-circle method is described. Safety factor equations and a flow chart are presented. Two factors of safety are computed, one according to the ratio of resisting to overturning moments, the other based on a reduction factor of the strength of the soil, bringing the soil mass to a limiting equilibrium. Pore pressures can be defined either by Skempton's pore pressure coefficient taken as characteristic of each soil or by a piezometric polygonal line. Limited only by the capacity of the computer, 14 different soils separated by polygonal lines having a maximum of 50 vortices can be included in the soil mass, and the material above the failure surface can be divided into a maximum of 100 slices. Results from stability analyses of 2 specific cases are given. (USBR)
W70-04538

8E. Rock Mechanics and Geology

ROCKBOLTING OF TUNNELS FOR STRUCTURAL SUPPORT, PART I --THEORETICAL ANALYSIS, PART II--DESIGN OF ROCKBOLT SYSTEMS,
California Univ., Berkeley; and Leeds, Hill and Jewett, Inc., San Francisco, Calif.
H. D. McNiven, and H. M. Ewoldsen.
Int J Rock Mech Mining Sci, Vol 6, No 5, p 465-497, Sept 1969. 32 p, 19 fig, 11 ref.

Descriptors: *Rock bolts, Rock mechanics, Rock properties, *Tunnels, Tunnel design, Compression, Displacements, Elastic theory, Numerical analysis, Slipping, Strain, Stress analysis, Stress distribution, Supports, Tension, Tensile stress, Theory, Tangential stress, *Theoretical analysis.
Identifiers: Rock pressures, *Tunnel supports, Compressive stress, Computer-aided design, Slip planes, Tectonic loads.

Theoretical analysis of stresses and preliminary rational design procedures for rock bolt systems in tunnels are presented for several idealized cases. Stress fields for a circular tunnel in a gravitating medium and the stress field created by a single rock bolt are developed. Computations are made to obtain typical stress fields and to demonstrate the influence of the historic state of stress on the stress field surrounding the tunnel. The tunnel is examined for tension, compression, and slip failures; designs of rock bolt systems to prevent failure are presented. (USBR)
W70-04142

SYSTEMATIC MAPPING OF FRACTURE MORPHOLOGY,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
R. J. Lutton.
Geol Soc Amer Bull, Vol 80, No 10, p 2061-2065, Oct 1969. 5 p, 4 fig, 8 ref.

Descriptors: *Fractures, *Fractures (Geology), Materials, Symbols, Rocks, Rock properties, Shear cracks, Tension, Cohesive soils, Cracks, *Morphology, Loads (Forces), Surfaces, Mapping, *Geologic mapping, *Geologic investigations, Brittle failures, Ductility, Fissures, Joints (Geology), Fissures (Geology), Cracking.
Identifiers: Fracture traces, Crack propagation, Rock breakage.

The morphological approach to the study of rock fractures has been neglected until recently, and still is not fully appreciated. This is caused partly by the general failure to recognize that similar features can be found on fractures over a great range of scales. The relatively simple and universal fracture morphology is shown in a great range of scales, material types, and loads. The characteristic fracture forms are incorporated into a system of mapping symbols that apply equally well for all nonshear fracture surfaces in a variety of materials. Fractures can be described graphically in this manner regardless of type of material and loading condition over a scale range of 7 or more orders of magnitude. Observations made at the submicroscopic, microscopic, megascopic, and perhaps larger scales could be interrelated in different fields of physical science. (USBR)
W70-04143

8F. Concrete

MIXING-IN-PLACE SOIL AND PORTLAND CEMENT.
For primary bibliographic entry see Field 08D.
W70-04530

CONCRETE REPAIR PROBLEMS: CAUSES AND CURES.

Concr Constr, Vol 14, No 11, pp 409-427, Nov, 1969. 16 p, 19 photo, 2 tab, 25 ref.

Descriptors: Concrete construction, Concrete structures, *Concrete technology, *Concretes, *Repairing, *Maintenance, *Rehabilitation, Deterioration, Alkali-aggregate reaction, Cracking, Cavitation, Crazing, Dusting, Efflorescence, Scaling, Stains, Sealing compounds, Protective coatings, Bibliographies.
Identifiers: *Concrete deterioration, Concrete properties, Concrete pavements, Concrete products, Crack control, Spalling.

For good results in repairing concrete, the causes of the deterioration must be determined. Sometimes the cause is readily apparent, but more frequently a skilled specialist or laboratory examination may be required. Some common causes of deterioration include alkali-aggregate reaction, cavitation, cracking, crazing, dusting, efflorescence, pop-outs, sandstreaking, scaling, spalling, stains, and uneven color. Recommended repair techniques include acid etching, calking, coating, replacement of concrete, dry-packing, grinding, jacketing, slab-jacking, resurfacing, sandblasting, stitching, and stressing. Some basic information is given on selecting repair materials. A veritable arsenal of repair materials and techniques is available for dealing with every type of deterioration. Concrete structures have the unique distinction of rarely being beyond repair. (USBR)
W70-04532

8G. Materials

ELASTOMER TECHNOLOGY,
Firestone Tire and Rubber Co., Akron, Ohio.
Fred C. Weissert
Ind Eng Chem, Vol 61, No 8, p 53-59, Aug 1969. 7 p, 116 ref.

Descriptors: *Elastomers, *Rubber, Molecular structure, Additives, Fillers, Elastic deformation, Elasticity (Mechanical), Bibliographies, Reviews, *Synthetic rubber, Polymers, Physical properties, Mechanical properties, Tires, Curing compounds, Sealing compounds, Adhesives, Materials engineering, *Chemical engineering, Research and development.
Identifiers: Polymerization, Viscoelasticity

Continued improvement in the performance of elastomer products requires further knowledge of the relationships between molecular structure and mechanical behavior of elastomeric compounds. During 1968, research investigations emphasized the macromolecular features such as molecular weight distribution, branching, and crosslinking. A second growing area of elastomer research is directed toward understanding the nature of the physical and chemical interaction between phases of polymer blends, and also between rubber and filler phases. The presence of 2 or more phases is generally essential in useful elastomeric products. Current developments in polymer elastomers and blends are discussed; recent research and development work on additive compounding ingredients is reviewed, including mechanical behavior of polymers and compounding ingredients, and testing for characterizing the variety of intended end use conditions.
W70-04131

ADHESIVES, 1969,
PPG Industries, Inc., Springdale, Pa.
C. Clement Anderson.
Ind Eng Chem, Vol 61, No 8, p 48-52, Aug 1969. 5 p, 5 fig, 8 tab, 41 ref.

Descriptors: *Adhesion, *Adhesives, Materials, Materials engineering, *Polymers, Interfaces, *Wettability, Wetting, Composite materials, Surface tension, Reviews, Bibliographies, *Bonding, Rubber, Elastomers, Epoxy resins, Curing.
Identifiers: Bonding agents, Bond strength, Polyurethane resins, Peeling, *Synthetic resins.

Progress in the development of synthetic polymer adhesives is reviewed, covering new bonding processes, pressure-sensitive adhesives, rubber-based adhesives, carboxylated adhesives, polyurethanes, new methods of analysis, and important aspects of adhesion such as wetting, contact angle, and other interfacial phenomena. An empirical relationship has been established between glass temperature and critical surface tension of a polymer. Studies on the wetting of surfaces by polymer melts show that the cosine of the contact angle attains its final value apparently according to second-order kinetics. The wettability and conformations of reactive polysiloxanes were investigated; a table gives the critical surface tensions. Studies of the interface in glass-epoxy composites showed that fracture occurred at the glass-resin interface when adhesion was poor, but deep within the resin matrix when adhesion was good; good adhesion was observed when a coupling agent capable of co-reacting with the epoxy resin and forming a covalent bond was used.

W70-04132

STAINLESS STEELS AND OTHER FERROUS ALLOYS,
Hercules, Inc., Wilmington, Del.
Hugh B. Fischer.
Ind Eng Chem, Vol 61, No 8, p 42-47, Aug 1969. 6 p, 192 ref.

Descriptors: *Steel, Steel plates, Steel pipes, *Stainless steel, Structural steel, Pressure vessels, *Welding, Specifications, Alloys, Manufacturing, Heat exchangers, Boilers, Materials, Reviews, Materials engineering, Bibliographies.
Identifiers: Steel tubing, Stress corrosion, *Alloy steels, Corrosion resistance, *Corrosion resistant alloys, Electron-beam welding.

Materials selection, corrosion resistance, new alloys, new manufacturing techniques, and welding are covered in a review on ferrous materials. The review will enable selecting materials and maintenance for satisfactory operation under corrosive conditions and under extreme temperature and pressure. Materials for heat exchangers, piping, boilers, and pressure vessels are included. References are given on corrosion resistance, specific corrosion data, and stress corrosion cracking. Developments of new alloys in the U.S. and elsewhere are reported, including an austenitic stainless steel resistant to stress corrosion cracking in sea water, new structural steels, and a series of new superplastic stainless steels. The present trend in welding is toward increased deposition rates and decreased heat output. Large-diameter pipelines have been routinely welded with a portable electron-beam welder.
W70-04133

PLASTICS CHEMISTRY AND ENGINEERING,
Houston Univ., Tex.
Raymond B. Seymour.
Ind Eng Chem, Vol 61, No 8, p 28-41, Aug 1969. 14 p, 1 tab, 712 ref.

Descriptors: *Plastics, *Polymers, *Materials engineering, *Chemical engineering, Industrial production, Building materials, Containers, Education, Reviews, Bibliographies, Structural members, Membranes, Sheeting, Composite materials, Foams, Plastic pipes, Synthetic fibers, Weathering, Aging (Physical), Durability.
Identifiers: Synthetic resins, Careers, Plastic foam, Corrosion resistance.

The annual growth rate of the synthetic polymer industry in the USA is almost 3 times the average for all other industries; the volume of polymer production is projected to exceed the volume of all other non-polymer materials by 1980. Uses for synthetic polymers are being found to replace conventional materials in packaging, building materials, automobiles, aircraft, and road paving. Developments in applications of plastics are reviewed for structural materials, containers and vessels, composite materials, sheets and film, foams, plastic pipe, and synthetic fibers. The weathering, durability, corrosion resistance, and flame resistance of polymers are discussed; characterization and testing are included. The phenomenal growth of the polymer industry may be retarded in the early 1970's because of the scarcity of polymer-oriented scientists and engineers. Education and career opportunities in polymer science and technology are discussed.
W70-04135

POLYMER COATINGS,
PPG Industries, Inc., Springdale, Pa.
N. H. Frick, H. L. Gerhart, and H. E. Gilbert.
Ind Eng Chem, Vol 61, No 8, p 60-75, Aug 1969. 16 p, 3 fig, 2 photo, 263 ref.

Descriptors: *Protective coatings, *Paints, *Polymers, Reviews, Test procedures, Bibliographies, Resins, Pigments, Formulation, Curing, Color, Characteristics, Physical properties, Weathering, Emulsions, Mildews, Materials engineering.
Identifiers: Polymerization, *Plastic coatings, Synthetic resins, Latex.

An annual review of developments in polymer coating technology is presented to indicate some new directions taken and to create an awareness of problems and solutions. The review is not a rote recitation of all the coatings literature published in the past years. Emphasis is given to the concepts having useful application and information of current concern on breakthrough research that gives greater insight. Not all segments of technological effort in polymer coatings are reported, and coverage of application technology is limited. Subjects discussed are formulation concepts, synthetic resins, high energy activation, performance and testing, characterization techniques, physical properties, weathering, pigments and color science, and mildew control.
W70-04137

OVERVOLTAGES APPEARING ON HVDC CABLES DUE TO CONVERTER OPERATION,
English Electric Co. Ltd., Stafford; and Allmanna Svenska Elektriska A.B., Ludvika.
J. D. Ainsworth, Arne Johanssen, and K. J. Ralls.
Direct Curr, Vol 1, No 2, p 83-88, Aug 1969. 6 p, 11 fig, 2 ref.

Descriptors: *Direct current, *Electric cables, Disturbances, Faults (Electrical), Converters (Electrical), Transmission (Electrical), Transients, Lightning, Transmission lines, *Conductors, Inverters, Rectifiers, Alternating current, Foreign research.
Identifiers: *Overvoltage, *High voltage, Switching surges, Induced voltage, Protection (Electrical), Lightning surges.

Overvoltages experienced in hvdc conductor systems are caused by: (1) malfunctioning of either valves, or valve firing, or control circuits; (2) faults occurring in the d-c system; (3) disturbances in the a-c system propagating through into the d-c system; (4) external sources, such as lightning striking d-c overhead lines; and (5) normal control operations such as blocking, deblocking, and starting transmission. The effects of these 5 types of disturbances are discussed, principally those caused by faults originating in the d-c converters and d-c lines, or from the a-c systems. The information given is for consideration of d-c cables only; numerical examples are for illustration because the actual values of overvoltages depend on the configuration of individual schemes.
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Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 05G.
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Vanderbilt University - Thermal Pollution	W70-04470, 04472 -- 04481 04483 -- 04487	16
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North Carolina State University - Textile Wastes	W70-04240 -- 04241 04243 -- 04244 04247 -- 04248 04541, 04542, 04060, 04084, 04087, 04148, 04167, 04197, 04218	17

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Illinois Water Resources Center	W70-04068 -- 04073	6
Oklahoma Water Resources Research Institute	W70-04074	1
Georgia Water Resources Center	W70-04295	1

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Subject Fields

1 NATURE OF WATER

2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

5 WATER QUALITY MANAGEMENT AND PROTECTION

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VOLUME 3, NUMBER 12
JUNE 15, 1970

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WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
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VOLUME 3, NUMBER 12
JUNE 15, 1970

W70-04544 -- W70-05043

of funds for printing this publication approved by the Director of the Bureau of the Budget, September 4, 1968.

06 WATER RESOURCES PLANNING
Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA
Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS
Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES
Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION
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ABSTRACT SOURCES

SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

1A. Properties

ENERGY BALANCES FOR TRANSIENT WATER CRATERS,
Geological Survey, Menlo Park, Calif.
K. L. R. Olevson.
Available for sale from Superintendent of Documents, US Government Printing Office, Washington, DC 20402-Price $3.75. Geological Survey Research 1969, Professional Paper 650-D, p D189-D194, 1969. 6 p, 4 fig, 2 tab, 11 ref.

Descriptors: *Water properties, *Waves (Water), *Drops (Fluids), *Impact (Rainfall), Energy, Kinetics, Energy dissipation, Energy transfer.
Identifiers: *Raindrop craters (Water), Water craters (Impact), Liquid-liquid impacts.

Studies of transient craters in water, produced by falling water drops, show that significant amounts of energy are present as kinetic energy in a cylindrical wave which surrounds the crater when the crater has reached its maximum size. At maximum size, about 80 to 90% of the initial drop kinetic energy can be accounted for as potential energy, surface energy, and kinetic energy of the outwardly expanding cylindrical wave. The energy partitioning changes with velocity and crater size. For 14-milligram drops with velocities near 155 centimeters per second, surface energy is the most important energy sink, whereas potential energy is the most important energy sink at velocities near 566 cm per second. The percentage of kinetic energy in the cylindrical wave increases with increasing drop velocity and may exceed the percentage of surface energy for the highest velocities. (Knapp-USGS)
W70-04562

02. WATER CYCLE

2A. General

A STOCHASTIC MODEL OF CONVECTIVE DIFFUSION FROM A CONTINUOUS SOURCE,
Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Civil Engineering.
George Bugliarello, and Eugene D. Jackson, III.
Text also printed in French. Journal of Hydraulic Research, Vol 7, No 2, p 177-204, 1969. 28 p, 12 fig, 1 tab, 9 ref.

Descriptors: *Diffusion, *Convection, *Mathematical models, Stochastic processes, Dispersion, Flow, Closed conduit flow, Steady flow, Statistical models, Tracers, Turbulent flow, Laminar flow.
Identifiers: Convective diffusion.

Stochastic methods can provide an alternative to conventional numerical techniques in the solution of the convective diffusion equation. A discrete model, consisting of a large number of particles, each executing in a discrete time interval a convective step and a random diffusive one, was used to simulate the diffusion pattern from continuous point sources in a laminar field. The treatment emphasizes methodological aspects and the type of information on the diffusion process that the simulation approach can most effectively provide. (Knapp-USGS)
W70-04563

URBAN EFFECTS ON WATER YIELD,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 04C.
W70-04574

EFFECTS OF URBANIZATION ON PEAK FLOWS,
Michigan Univ., Ann Arbor.
For primary bibliographic entry see Field 04C.
W70-04576

URBAN EFFECTS ON THE UNIT HYDROGRAPH,
Tracor, Inc., Austin, Tex.; and Texas Univ., Coll. of Engineering.
For primary bibliographic entry see Field 04C.
W70-04577

PRECIPITATION AND BASE RUNOFF, BIG PIPE CREEK BASIN, MARYLAND,
Geological Survey, Washington, D.C.
Frank W. Trainer.
Available for sale from Superintendent of Documents U S Government Printing Office, Washington, D C 20402-Price $3.75. Geological Survey Research 1969, Professional Paper 650-D, p D222-D227, 1969. 6 p, 3 fig, 18 ref.

Descriptors: *Surface-groundwater relationships, *Rainfall-runoff relationships, *Base flow, Hydrograph analysis, Model studies, Maryland, Groundwater movement, Recession curves, Evaporation, Hydrologic budget, Hydrogeology, Streamflow.
Identifiers: Base runoff.

Base runoff from a small river basin in the Piedmont province in Maryland was studied through hydrograph separation during design of a study model depicting groundwater and base runoff in part of the Potomac River basin. Subsequent base runoff derived from individual storms, believed to be approximately equal to groundwater recharge resulting from these storms, ranges from 25 to 31% of the precipitation in February-April to 7 to 9% in July-September. On the average, a given quantity of precipitation results in three to four times as much base runoff during winter and spring as during summer and autumn. (Knapp-USGS)
W70-04581

EFFECTS OF WATERSHED CHANGES ON STREAMFLOW,
Texas Univ., Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 04C.
W70-04723

LAND TREATMENT IN AGRICULTURAL WATERSHED HYDROLOGY RESEARCH,
Agricultural Research Service, Beltsville, Md. Soil and Water Conservation Research Div.
For primary bibliographic entry see Field 04D.
W70-04725

APPLICATION OF CONTINUOUS ACCOUNTING TECHNIQUES TO EVALUATE THE EFFECTS OF SMALL STRUCTURES ON MUKE-WATER CREEK, TEXAS,
Texas Univ., Austin, and Texas Tech Univ., Lubbock.
For primary bibliographic entry see Field 04C.
W70-04726

ANALYSIS OF WATERSHED CHANGES,
Hydrocomp International, Palo Alto, Calif.
For primary bibliographic entry see Field 07C.
W70-04728

POTENTIAL OF PHYSICAL MODELS FOR ACHIEVING BETTER UNDERSTANDING AND EVALUATION OF WATERSHED CHANGES,
Massachusetts Inst. of Tech., Cambridge.
Peter S. Eagleson.
In: Effects of Watershed Changes on Streamflow, Water Resources Symposium No 2, Austin, Texas, October 1968, p 12-25, University of Texas Press, Austin and London, 1969. 14 p, 5 fig, 22 ref.

Descriptors: *Rainfall-runoff relationships, *Model studies, *Hydraulic models, *Mathematical models, Statistical models, Hydraulic similitude, Simulation analysis, Routing, Runoff, Streamflow forecasting, Probability, Urbanization.
Identifiers: Watershed models, Watershed changes.

The construction, operation, and interpretation of hydraulic models and mathematical models of the rainfall-runoff relationships of watersheds are discussed. Emphasis is given to the effects of man made changes in watershed properties on their hydrologic performance. It is concluded that while there appears to be a class of watershed problems for which scale modeling may be a legitimate method study, the class is small and is included in that larger class for which digital computer solution of the equations of motion shows at least equal promise. The errors inherent in each approach have yet to be defined, but the digital computer should ultimately have a clear economic advantage. (See W70-04723). (Knapp-USGS)
W70-04729

THE ANNUAL MARCH OF THE TOPOCLIMATIC SPATIAL PATTERNS OF NET RADIATION IN SOUTHERN CALIFORNIA,
California Univ., Los Angeles. Dept. of Geography.
For primary bibliographic entry see Field 02B.
W70-04734

EFFECTS OF FOREST COVER MANIPULATION ON WATER YIELD AS STUDIED BY AN ELECTRIC ANALOG,
Washington Univ., Seattle. Coll. of Forest Resources.
For primary bibliographic entry see Field 03B.
W70-04854

EFFECT OF STORM RAINFALL VARIABILITY ON RUNOFF FROM SMALL SEMIARID WATERSHEDS,
Arizona Water Resources Research Center, Tucson.
Martin M. Fogel.
American Society of Agricultural Engineers, Transactions, Vol 12, No 6, p 808-812, November-December, 1969. 3 fig, 4 tab, 8 ref.

Descriptors: *Rainfall-runoff relationships, *Storm runoff, *Small watersheds, *Semiarid climates, *Regression analysis, Arizona, Seasonal, Summer, Precipitation (Atmospheric), Rainfall, Surface runoff, Duration, Spatial distribution, Variability, Convection, Depth-Area-Duration analysis, Equations, Storms, Estimating, Frequency analysis.
Identifiers: *Atterbury experimental watershed.

In the small semiarid watershed under study convective summer storms produce the heaviest runoff. The intensity, duration, frequency, and areal extent of these storms differ markedly from other storm types. A linear multiple-regression model was used in an attempt to discover the relative effects of depth of rainfall, its time distribution, and position of the storm over the watershed. Location of the storm had little or no effect on runoff if mean areal rainfall was used to characterize storm magnitude. The major influence in predicting runoff was mean rainfall, but time distribution of the storm did have a significant effect. In a comparison, the generally used U.S. Soil Conservation Service method was found to underestimate runoff for most storm rainfall depths and overestimate volume for extreme events. (Carr-Arizona)
W70-04910

2B. Precipitation

A GENERALIZED PROBABILITY MODEL FOR SEQUENCES OF WET AND DRY DAYS,
Liverpool Univ. (England).
J. R. Green.
Monthly Weather Review, Vol 98, No 3, p 238-241, March 1970. 4 p, 2 fig, 2 tab, 15 ref.

Descriptors: *Mathematical models, *Weather forecasting, Meteorology, Stochastic processes, Markov processes, Statistical models, Weather patterns.
Identifiers: Dry-day forecasts, Wet-day forecasts.

A generalization of the two main probability models used to describe runs of wet days or of dry days is given. The new model depends on only two parameters and is shown to fit a large proportion of available sets of data. (Knapp-USGS)
W70-04695

REMARKABLE POINT RAINFALL AT GREENFIELD, N.H., EVENING OF AUGUST 2, 1966,
Environmental Science Services Administration, Boston, Mass.
R. E. Lautzenheiser, A. E. Rothovius, and J. R. Sims.
Monthly Weather Review, Vol 98, No 2, p 164-168, February 1970. 5 p, 5 fig, 8 ref.

Descriptors: *Rainfall, *Rainfall intensity, *Distribution patterns, *New Hampshire, Rainfall disposition, Meteorology.
Identifiers: Small rain storms.

An excessive rain of very small areal extent fell late on Aug. 2, 1966, at Greenfield, N.H. The storm is described, related storm statistics are presented, the synoptic situation is reviewed, and the danger of interpreting point rainfall data as being representative of an area is shown. (Knapp-USGS)
W70-04698

A STATISTICAL SIMULATION TECHNIQUE FOR NORTHERN NEW JERSEY MONTHLY PRECIPITATION,
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Meteorology.
Peter P. Zwack, Mark D. Shulman, and John W. Philpot.
Water Resources Bulletin, Vol 5, No 4, p 9-15, December 1969. 7 p, 1 fig, 4 tab, 14 ref.

Descriptors: *Precipitation (Atmospheric), *New Jersey, *Simulated rainfall, *Statistical models, *Synthetic hydrology, Simulation analysis, Rainfall disposition, Statistics, Model studies, Mathematical models, Computers, Time series analysis.
Identifiers: Precipitation simulation.

A 30-year record of monthly precipitation for Northern New Jersey was analyzed for its statistical components. With a weak annual periodicity eliminated, the series was found to be random. The data for each month were fit with a gamma distribution using Thom's suggested best estimates of the distribution parameters. A 1,000-year simulated monthly precipitation series was generated using random values from the 12 gamma distributions. The statistical properties of the simulated and sample time series agreed well. Numerous anomalous precipitation regimes were observed in the simulated data. (Knapp-USGS)
W70-04718

A NOTE ON AREAL RAINFALL DEFINITION,
Agricultural Research Service, Beltsville, Md. Hydrograph Lab.
David M. Hershfield.
Water Resources Bulletin, Vol 5, No 4, p 49-55, December 1969. 7 p, 4 fig, 1 tab, 2 ref.

Descriptors: *Rainfall, *Distribution patterns, Statistical methods, Sampling, Mathematical studies, Probability, Instrumentation, Networks, Data collections, Rainfall disposition, Hydrology, Correlation analysis, Rain gages.
Identifiers: Rain gage networks.

Sources of error in defining areal rainfall on a storm basis include the instrumental error, sampling fluctuations over the area, and network density. Analysis of dense rain gage data show the magnitude of the errors resulting from the natural variability of rainfall. Except for one watershed in Arizona, the coefficient of variation, based on a sample of storm totals from the individual gages in various size areas, remains relatively constant with increasing area for a particular storm. The error due to rainfall variability over the area is probably the most important and must be considered in experiments which attempt to resolve small-area hydrologic problems. (Knapp-USGS)
W70-04719

FORECASTING SNOW AND RAIN FOR THE NEW YORK CITY AREA USING THE METHOD OF ORDERED STATISTICS,
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Meteorology.
A. Roger Greenway, and Mark D. Shulman.
Water Resources Bulletin, Vol 5, No 4, p 56-62, December 1969. 7 p, 1 tab, 6 ref.

Descriptors: *Weather forecasting, *Snow, *New York, Meteorology, Weather patterns, Precipitation (Atmospheric).
Identifiers: Snow forecasting.

The occurrence of rain and snow for New York City is examined in relation to atmospheric parameters at three levels for four first order weather bureau stations. An objective forecasting guide is developed using order statistic properties. Incorporating surface and upper level data, the guide is a highly accurate forecast tool. (Knapp-USGS)
W70-04720

THE ANNUAL MARCH OF THE TOPOCLIMATIC SPATIAL PATTERNS OF NET RADIATION IN SOUTHERN CALIFORNIA,
California Univ., Los Angeles. Dept. of Geography.
Werner H. Terjung, Ronald N. Kickert, Ronald J. Kochevar, Jack P. Mrowka, and Simon O. Ojo.
Archiv Meteorologie, Geophysik, und Bioklimatologie, Series B, Vol 13, p 21-50, 1969. 30 p, 16 fig, 3 tab, 50 ref.

Descriptors: *Solar radiation, *Mathematical models, *Synoptic analysis, *California, *Climatology, Albedo, Smog, Clouds, Topography, Slopes, Altitude, Urbanization, Meteorology, Heat balance.
Identifiers: Southern California.

A model based on theoretical knowledge of the physical modifications of solar energy by the atmosphere and its transformation at the surface, has been used to determine the monthly distribution of net radiation in southern California at a topoclimatic scale. Parameters utilized in the equations were cloud cover, cloud type, surface albedo, precipitable water vapor, surface temperature, slope angle, slope orientation, elevation, and urban smog. A remarkable contrast was found between relatively high net radiation values for the littoral and coastal mountains and those of the lower values of the arid eastern parts of southern California. (Knapp-USGS)
W70-04734

RELATIONSHIPS BETWEEN CLIMATE AND REGIONAL VARIATIONS IN SNOW-COVER DENSITY IN NORTH AMERICA,
Army Terrestrial Sciences Center, Hanover, N.H.
For primary bibliographic entry see Field 02C.
W70-04742

ASSESSMENT OF ATMOSPHERIC EFFECTS OF LAKE NASSER.
National Center for Atmospheric Research, Boulder, Colo.

In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 865-880, 1966. 16 p, 1 fig, 3 append.

Descriptors: *Lakes, *Climatology, *Arid lands, *Reservoirs, Microclimatology, Meteorology, Precipitation (Atmospheric), Synoptic analysis.
Identifiers: *Egypt, *Lake Nasser, *Nile River.

The possible meteorological effects of the filling of Lake Nasser, Egypt are discussed, considering information on final size of the lake. During the months of June, July and August, the Nile is in flood; the water flow is highest and the water temperatures lowest of the year. At this time, the basic circulation of the lower atmosphere in the region to be occupied by Lake Nasser is the most stable of the year; it is essentially from the north around the extended monsoon low over northwest India. Mean maximum daily temperatures at Aswan are approximately 42 deg C. Winds are calm to light in the early morning hours but by mid-morning pick up to about 10-15 meters per second, blowing generally as north-east trades, very nearly parallel to the main axis of the water body of Lake Nasser. There are no clouds, dew points range to - 4 deg C, and there are no intrusions of other air masses. It is the consensus of scientists queried that the influence, if any, will be on the micro-to-meso scale. There seems to be little reason to expect that the moisture entering the atmosphere from the lake will, in the absence of any possibility of uplift to adequately low temperatures, result in clouds, much less precipitation. While thunderstorms do occur in the region at certain times of the year, with concomitant winds at low levels strong enough to blow sand, there appears to be little expectation that the presence of the lake will have any significant influence on the frequency of occurrence or intensity of such thunderstorms. (Knapp-USGS)
W70-04756

AN ANNOTATED CLIMATOLOGICAL BIBLIOGRAPHY OF INDIA,
Environmental Technical Applications Center (Air Force), Washington, D.C.
Dennis L. Boyer, and Alvin L. Smith, Jr.
Technical Note 69-6, August, 1969. 55 p, 141 ref.

Descriptors: Climatology, *Bibliographies, *Climatic data, *Precipitation (Atmospheric), Air temperature, Thunderstorms.
Identifiers: *India.

This bibliography contains 141 climatological references, with annotations, for India. Items are indexed by author (alphabetically) and by subject matter. All items listed were published subsequent to 1959.
W70-04981

2C. Snow, Ice, and Frost

EVAPORATIVE FREEZING PROCESS FOR WATER DESALINATION,
Catholic Univ. of America, Washington, D.C.
For primary bibliographic entry see Field 03A.
W70-04649

SOME ESTIMATES OF THE THERMAL EFFECTS OF A HEATED PIPELINE IN PERMAFROST,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 08A.
W70-04694

SALT REJECTION BY SEA ICE DURING GROWTH,
Department of Energy, Mines and Resources, Dartmouth (Nova Scotia).
R. A. Lake, and E. L. Lewis.
Journal of Geophysical Research, Vol 75, No 3, p 583-597, January 20, 1970. 15 p, 10 fig, 1 tab, 18 ref.

Descriptors: *Sea ice, *Freezing, *Water chemistry, Sea water, Salts, Drainage, Structure, Physical properties, Crystal growth, Crystallization.
Identifiers: Salt rejection (Freezing).

Rejection of salt at a freezing ice-water interface takes place at least in part by cyclic convective processes occurring within the small interstitial spaces in the first few centimeters of ice above the interface. This invalidates the assumption of the

fusive boundary layer and shows that near-inter-
e temperatures are subject to cyclic variations.
is result should be generally true for phase
anges in aqueous solutions with floating ice, and
nust be considered as a modification to current
ories of solidification. Large vertical tubular
uctures with smaller tributary tubes exist in the
wing sea ice sheet; this arrangement indicates
rizontal migration of brine toward preferred
inage areas in a manner analogous to the
tchment area of a river and its tributaries. (K-
pp-USGS)
70-04703

LATION OF SNOWPACK ACCUMULATION
RED PINE STOCKING,
rest Service (USDA), Cadillac, Mich. North
ntral Forest Experiment Station.
ward A. Hansen.
rest Service Research Note NC-85, 1969. 4 p, 4
, 10 ref.

scriptors: *Snowpacks, *Vegetation effects,
orest management, Planting management, Snow
nagement, Watershed management, Red pine
es, Pine trees, Water yield.
ntifiers: Vegetation-snow cover relations.

snow accumulation study was conducted in a 33-
ar-old red pine plantation thinned to different
cking levels. Snowpack water content increased
average of 2% for each 10 square feet of basal
ea reduction, within the range of 60 to 180
uare feet of basal area. Reducing plantation
cking from 180 to 60 square feet of basal area
r acre would result in 1.4 to 1.9 inches of addi-
nal water in a winter when 6 to 8 inches of
ecipitation were received. (Knapp-USGS)
70-04717

NIC CONCENTRATION GRADIENTS IN
RMAFROST, BARROW, ALASKA,
my Terrestrial Sciences Center, Hanover, N.H.
r primary bibliographic entry see Field 02K.
70-04736

ME PHYSICAL PROPERTIES OF ALPINE
OW,
my Terrestrial Sciences Center, Hanover, N.H.
arles M. Keeler.
ld Regions Research and Engineering Laborato-
Research Report 271, December 1969. 70 p, 50
, 19 tab, 116 ref. DA Proj 1T061101A91A.

scriptors: *Snow, *Physical properties, Adhe-
n, Bulk density, Electrical properties, Porosity,
ermal properties, Temperature, Bearing
ength, Shear strength, Cryology, Rheology, Den-
y, Avalanches.
ntifiers: Snow physical properties.

e fundamental properties of snow grain size,
ape, and fabric (relationship between grains)
re measured, and these were related to the index
derived properties of bulk density, shear and
nsile strength, permeability for air, and the
lectric static permittivity and loss tangent. It was
ssible to show that: (1) snow strength is a func-
n of bond area; and (2) the rate of densification
low density snow can be explained in part by
gh stress concentrations (on the order of 100 mil-
n dynes/sq cm) at intergranular contacts and by
ch factors as riming on crystals. The effect of the
vironmental factors of time, temperature, and
avitational stress is difficult to study in situ
cause they are not independent variables. How-
er, it appears that their study is simplified when
e fundamental properties of snow are correlated
th index properties. (Knapp-USGS)
70-04739

ORE DRILLING THROUGH THE ANTARC-
C ICE SHEET,
my Terrestrial Sciences Center, Hanover, N.H.
rbert T. Ueda, and Donald E. Garfield.
Cold Regions Research and Engineering Laboratory Technical Report 231, December 1969. 19 p, 14 fig, 8 ref. DA Proj No 1T061101A91A.

Descriptors: *Ice, *Glaciers, *Antarctic, *Core drilling, Drilling, Rotary drilling, Drilling equipment, Sampling, Drill holes, Exploration, Subsurface investigations, Surveys, Drilling fluids, Heat flow.
Identifiers: Antarctic ice sheet, Ice coring.

The Antarctic ice sheet was penetrated by core drilling at Byrd Station during the 1967-68 austral summer. The drill was a cable-suspended electromechanical rotary type 87 ft long, weighing 2650 lb. Other equipment included 12,000 ft of armored electrical cable and a 70-ft-high aluminum tower. During 1966-67 the equipment was installed and a depth of 745 ft was drilled. Drilling resumed in November 1967 and the hole was completed in January 1968. Cores 10 to 20 ft long averaging 4 1/4 in. diam were recovered over 99% of the depth. The penetration rate averaged 70 ft/day. The drilling rate varied from 1.4 to 7.8 in./min at a power input of 7.5 to 9 kw. Drill cuttings were dissolved in an aqueous ethylene glycol solution circulated at the bottom of the hole and returned to the surface in the drill bailer on each coring run. Liquid water, indicative of pressure melting at the bottom of the ice sheet, was encountered at 7101 ft. Attempts to recover a core of sub-ice material were not successful. The hole began deviating from the vertical at 750-ft depth and, despite corrective measures, was inclined 15 deg at the bottom. Ice temperatures increased steadily from a minimum of -28.8 deg C at 2400 ft to -13.0 deg C at 5942 ft, where temperature measurement ceased. The heat flow for this location is estimated to be 1.8 microcal/sq cm/sec. (Knapp-USGS)
W70-04741

RELATIONSHIPS BETWEEN CLIMATE AND REGIONAL VARIATIONS IN SNOW-COVER DENSITY IN NORTH AMERICA,
Army Terrestrial Sciences Center, Hanover, N.H.
Michael A. Bilello.
Cold Regions Research and Engineering Laboratory Research Report 267, December 1969. 21 p, 6 fig, 3 tab, 26 ref, 1 append. DA Task 1T061102B52A02.

Descriptors: *Snow cover, *Climatology, *Density, Winds, Snow surveys, Temperature, Water yield, Snowfall.
Identifiers: *Snow density.

Analysis of snow-cover observations made during November to March at 27 stations in Alaska, Canada and the northern United States for a 2- to 11-year period showed that the average snow density can be classified in 4 general categories: Category 1 (density 0.20 to 0.23 g/cc), inland stations reporting light winds; Category 2 (0.24 to 0.27 g/cc), stations reporting moderate winds; Category 3 (0.28 to 0.30 g/cc), inland and coastal locations with stronger winds; Category 4 (0.32 to 0.36 g/cc), cold and windy stations of the Arctic. Skewness coefficients computed for each station showed bias toward lower densities for categories 1 and 2, and bias toward higher densities for categories 3 and 4. A nomograph in which the average winter air temperature and wind speed are the independent variables makes it possible to estimate the average snow-cover density for any location in the Arctic, subarctic and North Temperate Zones. A comparison between observed and estimated densities for 10 other test stations yielded a correlation coefficient of 0.91 with a standard error of estimate of 0.016 g/cc. An average snow density map of North America was drawn and the continent was divided into areas based on the 4 categories. (Knapp-USGS)
W70-04742

2D. Evaporation and Transpiration

THE EFFECT OF ALBEDO ON THE EVAPOTRANSPIRATION RATE,
Cornell Univ., Ithaca; New York State Coll. of Agriculture, Ithaca. Dept. of Agronomy.
Ido Seginer.
Agricultural Meteorology, Vol 6, No 1, p 5-31, January 1969. 12 fig, 3 tab, 20 ref.

Descriptors: *Model studies, *Albedo, *Irrigation effects, *Evapotranspiration control, *Soil surfaces, Solar radiation, Arid lands, Radiation, Equations, Energy budget, Air temperature, Absorption, Canopy, Irrigated land, Photosynthesis, Time, Wetting, Wind velocity.
Identifiers: *Net radiation, *Reflectivity.

A model was used to evaluate the possibility of increasing the albedo of irrigated fields in order to reduce evapotranspiration. The results indicate that for infinite homogeneous fields the major factors determining the evaporation rate were albedo and wetness of surface. Following treatment savings in water were calculated to be 30% for all wetness conditions, with a 30% relative reduction in net radiation and a 20% reduction in solar radiation absorbed at the surface. Field experiments will be necessary to test these predictions. (Carr-Arizona)
W70-04919

A MODEL FOR SIMULATING SOIL WATER REGIME IN ALTERNATING FALLOW-CROP SYSTEMS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Land Research and Regional Survey.
E. A. Fitzpatrick, and H. A. Nix.
Agricultural Meteorology, Vol 6, No 5, p 303-319, September 1969. 8 fig, 1 tab, 36 ref.

Descriptors: *Model studies, *Evaporation, *Evapotranspiration, *Soil water, *Fallowing, Crop production, Semiarid climates, Cotton, Sorghum, Wheat, Water loss, Water balance, Meteorological data, Climatology, Soil-water-plant relationships.
Identifiers: *Soil water reserves, Agronomic practices, Queensland, Australia.

A set of simple working functions depicting evaporative loss from an alternating fallow-crop system was used in a model for simulating soil water regime in sub-humid to semi-arid central Queensland. Despite inadequacies in the data, the model closely simulated changes over time in the soil water regime. This was achieved by using distinctive functions for fallowed and cropped intervals and by making evapotranspiration rates dependent upon status of available soil water and stage of crop development. Data were sufficient to allow formulation of functions for cotton, sorghum, and wheat. The model makes provision for future refinements in data and appears promising as a basis for assessing effects of varied agronomic practices on available soil water reserves. (Carr-Arizona)
W70-04920

CHANGES IN CANOPY RESISTANCE TO WATER LOSS FROM ALFALFA INDUCED BY SOIL WATER DEPLETION,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.; and Army Electronics Command, Fort Huachuca, Ariz. Atmospheric Sciences Lab.
C. H. M. Van Bavel.
Agricultural Meteorology, Vol 4, No 3, p 165-176, May 1967. 10 fig, 1 tab, 1 append, 19 ref.

Descriptors: *Evaporation, *Soil-water-plant relationships, *Moisture stress, *Canopy, *Irrigation effects, Plant physiology, Irrigation, Alfalfa, Arizona, Arid lands, Diurnal, Stomata, Water loss, Resistance, Equations, Meteorological data, Energy budget.

Identifiers: *Canopy resistance.

An Arizona alfalfa field was irrigated and then allowed to deplete its soil water reserves down to -15 bars. The ratio between actual and potential evaporation was followed hourly, and when it dropped significantly below unity was interpreted as canopy resistance to evaporation. This resistance followed a diurnal pattern, with low values in the early morning, a rapid increase in early afternoon, and a decrease toward evening. It was not until 20 days after irrigation that resistance became noticeable during the day. However, from that time until the end of the experiment resistance rose rapidly and on the last day of measurement showed a value of 15 sec/cm. It would appear from the data that alfalfa stomata hold evaporation to a daily maximum value which declines as soil water is depleted. (Carr- Arizona)
W70-04921

NET AND SOLAR RADIATION RELATIONS OVER IRRIGATED FIELD CROPS,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
Leo J. Fritschen.
Agricultural Meteorology, Vol 4, No 1, p 55-62. 1 tab, 12 ref. Jan 1967.

Descriptors: *Irrigation water, *Regression analysis, *Solar radiation, *Evapotranspiration, *Albedo, Irrigation design, Water conservation, Arid lands, Irrigation efficiency, Arizona, Radiation, Surfaces, On-site data collections, Meteorological data, Data collections, Analytical techniques, Crops.
Identifiers: *Net radiation, Linear regression.

In an attempt to determine the relation between solar radiation and net radiation, data were collected over field crops of alfalfa, barley, cotton, oats, sorghum, and wheat. Field data were analyzed by linear regression techniques and the standard error which resulted from the pooled data was 0.06 ly/min. If net radiation were estimated from solar radiation for a 12-hour day with 649 ly incoming radiation, a standard error of approximately 10% would result. This pooled regression would be sufficiently accurate to estimate evapotranspiration in the design of irrigation projects, but the error would be too large in cases needing daily evapotranspiration results. In studying the reflectivity of crop surfaces, it appears that water may be conserved by increasing the surface albedo of crops and of wet bare soil. (Carr-Arizona)
W70-04922

CLIMATE AND ESTIMATED WATER USE BY AN ORANGE ORCHARD,
California Univ., Riverside; and Arizona Agricultural Experiment Station, Tucson.
C. H. M. Van Bavel, J. E. Newman, and R. H. Hilgeman.
Agricultural Meteorology, Vol 4, No 1, p 27-37, January 1967. 4 tab, 10 ref.

Descriptors: *Evapotranspiration, *Climates, *Arid climates, *Orchards, *Water utilization, Oranges, Stomata, Canopy, Wind velocity, Arizona, Equations, Meteorological data, Leaves, Evaporation, Evaporation pans, Data collections, Air temperature, Analytical techniques, Resistance, Water vapor.
Identifiers: *Canopy resistance, Penman equation.

A modified Penman equation applied to commonly logged climatic data was used to estimate potential evapotranspiration from orange trees under arid conditions in Arizona. Due to canopy resistance to evaporation, actual water use was much lower than the potential rate. There were further indications that in an arid environment evaporation from citrus groves is inversely related to wind speed and that aging leaves show increased values of canopy resistance. These results demonstrate the potential value of a physical approach to the prediction of crop water use. (Carr-Arizona)
W70-04923

AN INDEX OF CROP WATER STRESS RELATED TO WHEAT AND GRAIN SORGHUM YIELDS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Land Research and Regional Survey.
H. A. Nix, and E. A. Fitzpatrick.
Agricultural Meteorology, Vol 6, No 5, p 321-337, September 1969. 4 fig, 4 tab, 3 append, 21 ref.

Descriptors: *Moisture stress, *Crop production, *Evapotranspiration, *Soil-water-plant relationships, *Soil water, Moisture deficit, Climatic data, Rainfall, Plant physiology, Wheat, Sorghum, Environmental effects, Data collections, Regression analysis, Phenology.
Identifiers: *Stress index, *Queensland, Australia.

Soil-water regimes for wheat and grain sorghum were studied in experiments in central Queensland. Analysis of the ratio of estimated actual to potential evapotranspiration at defined intervals of growth for both crops revealed a critical growth period from ear emergence to early grain development. Ratios calculated for this 'critical' period correlated more closely with yield than other indices used to characterize crop water environment. A simple index incorporating available soil water supply and potential evaporative demand gave highly significant correlations with yields. This index accounted for 60-83% of the yield variation within the different varieties under study. After checking these findings against wheat yield data in Queensland for the 1952-1965 period, it would appear that intra-seasonal and year-to-year variation in yield is largely a function of anthesis date in relation to the then prevailing environmental moisture stress. (Carr-Arizona)
W70-04924

2E. Streamflow and Runoff

HYDROLOGIC SYSTEM RELATED TO GEOLOGY AND SOILS, FOUR MILE CREEK AREA, TAMA COUNTY, IOWA,
Soil Conservation Service, Iowa City, Iowa; and Iowa State Water Resources Research Inst., Ames.
R. V. Ruhe, and W. J. Vreeken.
Available from the Clearinghouse as PB-190 166, $3.00 in paper copy, $0.65 in microfiche. Iowa State University Water Resources Research Institute Project Completion Report, December 31, 1969. 44 p, 37 fig, 5 plate, 1 tab, 15 ref. OWRR Project No A-014-IA.

Descriptors: *Hydrogeology, *Rainfall-runoff relationships, *Iowa, *Loess, Glacial drift, Topography, Geology, Discharge (Water), Runoff, Water yield, Base flow, Erosion, Scour, Channel morphology, Hydrographs, Statistical methods.
Identifiers: Four Mile Creek (Iowa), Tama County (Iowa).

Topography in the Four Mile Creek area, Iowa consists of stepped levels that rise along interfluves from the main valley to divides. The drainage net is incised along tributary and side streams. Maximum relief in the area is 135 feet. Wisconsin loess covers 54% of the area and buries paleosols and glacial till. The loess varies in thickness from 4 to 35 feet. Alluvium is confined to the main, tributary, and side valleys. The main valley alluvium occupies 22% of the area. In relatively drier years, runoff is only 4 to 6% of rainfall, and in wetter years, runoff may be 11 to 17% of rainfall. The hydrologic regimen within small first-order watersheds in loess is related to stratigraphic zoning in the loess reservoir and to topography inherited from paleogeomorphic surfaces. These surfaces have associated clayey paleosols that are more impermeable than the loess. Parts of the buried surfaces are cut in till, also more impermeable than the loess. Subsurface water transmits downward and laterally through the permeable loess reservoir above the buried surfaces to alluvium along the first-order drainage. The subsurface water subsequently flows to alluvium of higher order valleys in the drainage net and ultimately to the main alluvial body along Four Mile Creek. (Knapp-USGS)
W70-04545

VISUALIZATION OF SPIRAL MOTION IN CURVED OPEN CHANNELS OF LARGE WIDTH,
Imperial Coll. of Science and Techology, London (England).
J. R. D. Francis, and A. F. Asfari.
Nature, Vol 225, No 5234, p 725-728, February 1970. 4 p, 8 fig, 3 ref.

Descriptors: *Open channel flow, *Meanders, *Vortices, *Hydraulic models, *Photography, Instrumentation, Flumes, Lighting, Cameras, Model studies, Turbulent flow, Streamflow, Tracers, Tracking techniques.
Identifiers: Spiral flow.

A method is described for observing motions in two laboratory open channels of 180 deg bends of different curvature and width. The secondary currents responsible for forming the spiral motion were made visible and recorded by a photographic technique. Photographs of the secondary currents were taken using exposures at two cross-sections, and at two depths of flow (h=7.6 cm and 3.75 cm). The patterns of secondary flow at these cross-sections were recorded by photographing, in a direction perpendicular to the cross-section concerned, illuminated tracer particles. Two tracer agents were used: in laminar flow, a plastic powder, specific gravity, 0.96; particle size range, 0.1-0.2 mm; in turbulent flow, droplets of a mixture of nitrobenzene, olive oil and water. The study concludes that when the aspect ratio of the flow (b/h) increases, the strength of secondary currents, as represented by the flow deviation from the circumferential direction, decreases. (Knapp-USGS)
W70-04553

TRANSFERRING STREAMFLOW CHARACTERISTICS,
Geological Survey, Washington, D.C.
H. C. Riggs.
ASCE Meeting Preprint 1093, American Society Civil Engineers Meeting, Jan 26-30, 1970, Memphis, Tennessee. 18 p, 5 fig, 1 tab, 7 ref.

Descriptors: *Streamflow forecasting, *Statistical methods, Regression analysis, Rainfall-runoff relationships, Hydrologic data, Data processing, Hydrographs, Water measurement, Forecasting, Estimating, Sampling.
Identifiers: Streamflow characteristics transfer.

The design of water-resource developments and protection works requires estimates of the statistical characteristics of streamflows such as flood peaks and annual minimum flows of selected recurrence intervals, and annual and seasonal means and their variabilities. At gaged sites, these characteristics may be obtained directly from the streamflow records. At ungaged sites, to transfer natural-flow data, a general procedure called regionalization uses data from many gaged sites in a region to produce a relation applicable to any ungaged site in that region. Other methods transfer information from one gaged site to a specific ungaged site at which a small amount of information has been collected. Four general procedures for transferring flow characteristics are described. (Knapp-USGS)
W70-04554

ACCURACY OF STREAMFLOW CHARACTERISTICS,
Geological Survey, Washington, D.C.
Clayton H. Hardison.
Available for sale from Superintendent of Documents U S Government Printing Office, Washington, D C 20402-Price $3.75. Geological Survey Research 1969, Professional Paper 650-D, p D210-D214, 1969. 5 p, 3 fig, 4 tab, 5 ref.

Descriptors: *Streamflow forecasting, *Analytical techniques, *Statistical methods, *Data processing, Correlation analysis, Regression analysis, Sampling, Data collections, Estimating.

Identifiers: Streamflow characteristics, Data accuracy, Error analysis.

Streamflow information, which is one of the end products of the Water Resources Division of the U. S. Geological Survey, may be obtained directly from a streamflow record or may be derived from base data by analytical methods. In either case, accuracy goals for the information obtained are needed to test the adequacy of the information and to design the data-collection system upon which the information is based. It is proposed that the accuracy goal for each streamflow characteristic be set equivalent to the accuracy with which that characteristic could be estimated from an observed record of some stipulated length. Curves and tables are presented in this paper to aid in setting such goals. (Knapp-USGS)
W70-04564

RELATION OF THE MANNING COEFFICIENT TO MEASURED BED ROUGHNESS IN STABLE NATURAL CHANNELS,
Geological Survey, Menlo Park, Calif.
J. T. Limerinos.
Available for sale from Superintendent of Documents U S Government Printing Office, Washington, D C 20402 Price $3.75. Geological Survey Research 1969, Professional Paper 650-D, p D215-D221, 1969. 7 p, 1 fig, 3 tab, 6 ref.

Descriptors: *Roughness (Hydraulic), *Mannings equation, Alluvial channels, Particle size, Particle shape, Statistical methods, Regression analysis, Roughness coefficient, Flow resistance.
Identifiers: Particle smoothness (Hydraulic).

An objective method of determining basic values of the Manning roughness coefficient was studied in channels with coarse bed material. Data were obtained from 50 current-meter measurements of discharge and appropriate field surveys at 11 sites on California streams. Characteristic bed-particle sizes, including the 16-, 50-, and 84-percentile sizes, for both minimum and intermediate axes were used to find the best relation between the roughness parameter and relative smoothness. The relations best fitting the field data were obtained when the characteristic particle size was either the 84-percentile d84 or a weighted composite size dw. Percentage differences for the 50 observed and computed values of n involving either d84 or dw had a standard deviation of about 19%. The form of the derived equations, using d84 or dw, was virtually identical with theoretical equations presented by Chow in 1959 and Vennard in 1961 and with an equation derived from field data by Leopold and Wolman in 1957. (Knapp-USGS)
W70-04565

EFFECTS OF SMALL STRUCTURES ON PEAK FLOW,
Soil Conservation Service, Fort Worth, Tex. Engineering and Watershed Planning Unit.
For primary bibliographic entry see Field 04A.
W70-04571

FIELD EXPERIMENT ON WASHITA RIVER,
Agricultural Research Service, Chickasha, Okla. Southern Plains Branch.
For primary bibliographic entry see Field 04D.
W70-04572

EFFECTS OF URBANIZATION ON PEAK FLOWS,
Michigan Univ., Ann Arbor.
For primary bibliographic entry see Field 04C.
W70-04576

EXPERIENCE WITH THE EVALUATION OF URBAN EFFECTS FOR DRAINAGE DESIGN,
Turner, Collie and Braden Co., Inc., Houston, Tex.
For primary bibliographic entry see Field 04C.
W70-04578

PRECIPITATION AND BASE RUNOFF, BIG PIPE CREEK BASIN, MARYLAND,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02A.
W70-04581

ON THE SUBJECT OF A FLOOD PROPAGATION COMPUTATION METHOD (MUSKINGUM METHOD),
Societe Grenobloise d'Etude et d'Applications Hydrauliques (France).
J. A. Cunge.
Text also printed in French. Journal of Hydraulic Research, Vol 7, No 2, p 205-230, 1969. 26 p, 5 fig, 5 ref.

Descriptors: *Routing, *Mathematical studies, *Flood routing, *Stage-discharge relations, Computers, Mathematical models, Discharge (Water), Flood forecasting, Hydrology.
Identifiers: Muskingum method, Saint-Venant equations.

The Muskingum flood wave propagation computation method and variants of it are in current use. It is a convenient method as the computer calculations can be rapidly carried out even with a machine of limited capacity. The basic assumption for the method is that the stage/discharge relationship is one-to-one, and strictly applied, this assumption leads to a differential equation whose analytical solution does not allow for wave damping. The Muskingum method, however, gives the attenuation of a wave travelling along a stream. Analysis of the Muskingum formula shows it also to be a finite-difference approximation of another differential equation derived from the Saint-Venant equations by neglecting the inertia terms. There is a solution to this equation which allows for damping of the flood wave. By comparing this differential equation with the Muskingum formula the coefficients of the latter can be determined from the physical river characteristics, but the stage/discharge relationship can then no longer be assumed to remain one-to-one. (Knapp-USGS)
W70-04590

RECONNAISSANCE OF THE WATER RESOURCES OF THE FORT SMITH QUADRANGLE, EAST-CENTRAL OKLAHOMA,
Geological Survey, Oklahoma City, Okla.
For primary bibliographic entry see Field 02F.
W70-04601

FLOOD OF AUGUST 1969, BON AIR QUADRANGLE, RICHMOND, VIRGINIA,
Geological Survey, Washington, D.C.
E. M. Miller.
Geological Survey Hydrologic Investigations Atlas HA-409, 1 sheet, 1969. Text, 2 fig, 1 photo, 1 map, 1 tab.

Descriptors: *Floods, *Virginia, *Hurricanes, *Historic flood, Cloudbursts, Peak discharge, Rain, Rain water, River flow, Storm runoff, Stage-discharge relations.
Identifiers: James River (Va), Richmond (Va).

The approximate areas inundated in and near Richmond, Va., by the flood of August 22, 1969, on the James River are shown on a topographic map. The flood was caused by torrential rains brought by the remnants of Hurricane Camille. The flood of May 1771 is considered the greatest in the James River basin since the settlement of Jamestown in 1607. The August 1969 flood at the Virginia Division of Water Resources gaging station, 0.1 mile upstream from the Huguenot Memorial Bridge (river mile 111.7), reached a stage of 24.95 feet, gage datum, (discharge, 222,000 cfs) and was the highest for the period of record (1935-69). At the U. S. Weather Bureau gaging station at river mile 103.7, the flood reached a stage of 28.6 feet, msl, (29.9 ft at former site of U. S. Weather Bureau gaging station at river mile 104.6), and was the highest since the great flood of 1771. (Knapp-USGS)
W70-04602

BIG BLUE RIVER BASIN.
Nebraska Soil and Water Conservation Commission, Lincoln.

Nebraska State Water Plan Publication No 201, September 1968. 103 p, 21 fig, 22 tab, 13 ref.

Descriptors: *Water resources development, *Groundwater, *Surface waters, *Nebraska, Irrigation water, Recreation, Flood control, Erosion control, Reservoirs, Planning, Hydrogeology, Hydrology, Geology.
Identifiers: Big Blue River basin (Nebr).

The Big Blue River basin of Nebraska has large acreages of deep productive soils, highly variable but generally adequate rainfall, and somewhat erratic streamflow. The major industry in the basin is diversified agriculture and related agriculturally oriented enterprises. This area is predominantly agricultural in nature. Groundwater storage reservoirs are quite extensive in the upper and central parts of the basin. The groundwater table is currently declining in localized areas of high concentration of irrigation wells. The main source of irrigation water has been from groundwater but excessive rates of water level decline in some areas indicate that better water management is needed. The primary needs evidenced in the basin are: flood control in the lower reaches of the streams, stabilization of the groundwater table in the upper and central basin, erosion control throughout the basin, drainage of certain depressional areas in the upper and central basin, stabilization of the economy, and provision of more recreation opportunity, especially water-oriented recreation. (Knapp-USGS)
W70-04603

FLOOD PLAIN INFORMATION, KIHEI, MAUI, HAWAII.
Corps of Engineers, Honolulu, Hawaii.
For primary bibliographic entry see Field 04A.
W70-04713

EFFECTS OF WATERSHED CHANGES ON STREAMFLOW,
Texas Univ., Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 04C.
W70-04723

FLOOD PLAIN INFORMATION, HORSE CREEK, AIKEN COUNTY, SOUTH CAROLINA.
Corps of Engineers, Savannah, Ga.
For primary bibliographic entry see Field 04A.
W70-04738

STORAGE REQUIRED FOR DIFFERENT TYPES OF STREAM FLOW REGULATION,
For primary bibliographic entry see Field 04A.
W70-04744

DETERMINATION OF THE REQUIRED RESERVOIR STORAGE FOR IRRIGATION UNDER THE CONDITIONS OF COMPENSATION DRAFT,
For primary bibliographic entry see Field 04A.
W70-04745

THE OPERATION OF REGULATING RESERVOIRS,
Water Resource Board, Reading (England). Research Div.
For primary bibliographic entry see Field 04A.
W70-04746

FLOOD PREVENTION BY ENLARGEMENT OF FLOOD WAVE SUBSIDENCE,
For primary bibliographic entry see Field 04A.
W70-04750

URBAN SPRAWL AND FLOODING IN SOUTHERN CALIFORNIA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 04C.
W70-04832

EFFECT OF STORM RAINFALL VARIABILITY ON RUNOFF FROM SMALL SEMIARID WATERSHEDS,
Arizona Water Resources Research Center, Tucson.
For primary bibliographic entry see Field 02A.
W70-04910

EFFECT OF CHANNEL STRAIGHTENING ON THE MOVEMENT OF FLOOD WAVES ON BOYER RIVER,
Iowa State Water Resources Research Inst., Ames.
For primary bibliographic entry see Field 04A.
W70-04984

METHODS FOR FORECASTING OF WATER INFLOW TO RIVERS AND RESERVOIRS,
Hydrometeorological Centre, Moscow (USSR).
For primary bibliographic entry see Field 04A.
W70-05019

GENERALIZED EVALUATIONS OF THE PROBABILITY OF RESERVOIR EMPTINESS WITH GAUSSIAN OR GAMMA INPUTS FOR THE TWO-SEASON CASE,
Water Research Association, Medmenham (England).
For primary bibliographic entry see Field 04A.
W70-05020

BEHAVIOR OF CHANNELS UPSTREAM FROM RESERVOIRS,
Geological Survey, Tucson, Ariz.
Thomas Maddock, Jr.
French resume included. In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 812-823, 1966. 12 p, 6 fig, 10 ref.

Descriptors: *Alluvial channels, *Reservoirs, *Sedimentation, Sediment transport, Deposition (Sediments), Aggradation, Sediment control, Vegetation effects, Reservoir silting, Channel morphology, Roughness (Hydraulic).
Identifiers: Upstream channels (Reservoirs).

Channel gradients above and below reservoirs, and even check dams have had little study. Recent statistical studies of gradients above check dams have been inconclusive. It is shown that the important factor yet unconsidered is the hydraulic relative roughness of the channel before and after the construction of the impeding structure. Since, for the same purely alluvial channel, roughness of an aggrading stream is less than that for a 'normal' stream, the gradients above dams are usually less than the natural gradient of a stream. Growth of vegetation introduces a complicating factor into the behavior of channels in alluvium. Sediment deposits behind dams are likely places for heavy vegetative growth. This may result in the deposit of unusual amounts of fine grained sediment and an increase in the stream gradient. Thus, the final gradient of a channel upstream from an obstruction may be largely dependent on the character of the vegetation growing on the newly laid deposits of sediment. (Knapp-USGS)
W70-05023

HYDROLOGIC DATA FOR RESERVOIR DESIGN,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07A.
W70-05026

ON THE SAFETY GIVEN BY A SEASONAL REGULATION RESERVOIR. (IN FRENCH),
Electricite de France, Chatou. Centre de Recherches et d'Essais.
For primary bibliographic entry see Field 04A.
W70-05028

APPLICATIONS OF TWO-SEASON STATISTICS TO RESERVOIR YIELD CALCULATION,
Water Research Association, Medmenham (England).
For primary bibliographic entry see Field 04A.
W70-05029

DISPOSABLE VOLUMES AND FLOW CONTROL IN HYDROELECTRIC RESERVOIRS. (IN FRENCH),
Electricite de France, Grenoble. General Technical Div.
For primary bibliographic entry see Field 04A.
W70-05030

PROBABILISTIC RESERVOIR DESIGN,
Lancaster Univ., Bailrigg (England). Dept. of Mathematics.
For primary bibliographic entry see Field 04A.
W70-05031

APPLICATION OF A METHOD BASED ON THE CALCULUS OF PROBABILITY IN THE ELABORATION OF HYDROLOGIC DATA,
Ente Nazionale per l'Energia Elettrica, Venice (Italy).
For primary bibliographic entry see Field 04A.
W70-05032

DETERMINATION OF THE ECONOMIC CAPACITY OF STORAGE RESERVOIRS,
Reditelstvi Vodnich Toku, Prague (Czechoslovakia).
For primary bibliographic entry see Field 04A.
W70-05033

USING MAPS TO ESTIMATE THE TOTAL WATER STORAGE OF LITTLE RESERVOIRS OF A REGION. (IN FRENCH),
Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France).
Pierre Dubreuil.
In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 551-558, 1966. 8 p, 3 fig, 2 ref.

Descriptors: *Water storage, *Reservoirs, *Estimation, Maps, Channel morphology, Depth, Streamflow forecasting, Statistical methods.
Identifiers: *Brazil.

Water storage in tens of thousands of small reservoirs in the Brazilian north-eastern region is estimated using a sample of 200 reservoirs, all physical characteristics of which are known. It is possible to establish relations to eliminate the pool depth and thalweg form factors. Then the storage capacities can be calculated from the pool surface and drainage basin length, both measured on maps. On the total volume, the error is not expected to exceed 25%. (Knapp-USGS)
W70-05034

2F. Groundwater

HYDROLOGIC SYSTEM RELATED TO GEOLOGY AND SOILS, FOUR MILE CREEK AREA, TAMA COUNTY, IOWA,
Soil Conservation Service, Iowa City, Iowa; and Iowa State Water Resources Research Inst., Ames.
For primary bibliographic entry see Field 02E.
W70-04545

ESTIMATE OF UNDERFLOW IN THE BIOBRARA RIVER BASIN ACROSS THE WYOMING-NEBRASKA STATE LINE,
Geological Survey, Lincoln, Nebr. Water Resources Div.
H. M. Babcock, and C. F. Keech.
Geological Survey Open-file report, May 1969 (revised). 15 p, 2 fig, 1 plate, 3 tab.

Descriptors: *Groundwater movement, Underflow, *Wyoming, *Nebraska, Groundwater basins, Water resources development, Water yield, Discharge (Water).
Identifiers: Niobrara River basin (Wyo-Neb).

Underflow at the Wyoming-Nebraska State line was estimated by applying Darcy's law to measured permeabilities and water levels, and by water budget methods. The coefficient of transmissibility of the Arikaree Group along the Wyoming-Nebraska State line is estimated to be between 15,000 and 30,000 gpd per foot. The underflow is estimated to be between about 5,000,000 and 8,000,000 gpd. Of the factors used in determining the amount of underflow, the largest probable error lies in the determination of the coefficient of permeability. (Knapp-USGS)
W70-04593

SPRINGS IN THE OZARK REGION, NORTHEASTERN OKLAHOMA,
Geological Survey, Oklahoma City, Okla. Water Resources Div.
Roy H. Bingham.
Oklahoma Geology Notes, Vol 29, No 6, Oklahoma Geological Survey, p 135-145, December 1969. 11 p, 7 fig, 3 tab, 4 ref.

Descriptors: *Springs, *Oklahoma, Karst, Recharge, Discharge (Water), Water yield, Water quality, Hydrogeology, Hydrologic data, Runoff, Aquifers.
Identifiers: Ozark Region (Okla).

Springs are a large potential source of good quality water in northeastern Oklahoma. Discharge measurements during September and October 1968 show that 26 of the largest springs were flowing about 21 mgd, an amount sufficient to furnish domestic supplies to a population of about 200,000. Data on the springs were collected during a reconnaissance of the water resources in the Tulsa quadrangle. The existence and location of springs in this regions depend upon the position of the water table, the topography of the area, and the lithology and structure of the geologic formations. The only geologic features described are those that are necessary to provide an understanding of the physical framework through which groundwater moves. (Knapp-USGS)
W70-04594

VISCO-ELASTIC THEORY OF THE DEFORMATION OF A CONFINED AQUIFER,
Kyoto Univ. (Japan). Disasters Prevention Research Inst.
Yoshiaki Fukuo.
Bulletin of the Disaster Prevention Research Institute, Vol 19, Part 1, Paper 150, p 1-13, August 1969. 13 p, 4 fig, 6 ref.

Descriptors: *Aquifers, *Groundwater movement, *Elastic deformation, *Elasticity (Mechanical), Rock properties, Aquicludes, Artesian wells, Water levels, Confined water.
Identifiers: Confined aquifers, Aquifer elasticity, Pore water.

A dynamic theory was derived for the deformation of a granular solid saturated with a liquid, assuming that the liquid filling up the pore space is a Newtonian viscous fluid and that the skeleton constituted by solid particles is a linear visco-elastic solid. The theory consists of the three fundamental equations, that is, the equations of motion of the liquid and the skeleton and the equation of continuity between the particles and the liquid. If the particle and liquid are taken to be incompressible

and the deformation of soil takes place on a quasi-static process, these equations are accepted as the theory of three-dimensional consolidation, including Terzaghi's well-known equation as a special case, and are also recognized as the basic equations of motion of confined groundwater in a visco-elastic aquifer. A theoretical example shows the rheological deformation of an infinite confined aquifer with uniform thickness caused by pumping water at a constant rate. (Knapp-USGS)
W70-04595

AVAILABILITY OF GROUNDWATER FOR IRRIGATION IN CHEYENNE COUNTY, NEBRASKA,
Nebraska Univ., Lincoln. Conservation and Survey Div.
Frank A. Smith.
Nebraska University Conservation and Survey Division Report, April 1969. 10 p, 1 fig, 1 tab, append.

Descriptors: *Water resources, *Groundwater, *Irrigation water, *Nebraska, Alluvium, Hydrogeology, Water yield, Water levels, Water table, Transmissivity, Water wells, Aquifers.
Identifiers: Cheyenne County (Nebr).

Three different stratigraphic units are sources of water supplies in Cheyenne County, Nebraska. Most wells in valleys tap either alluvial deposits of Quaternary age or the underlying Brule Formation of Tertiary age; a few may tap the Ogallala Formation, also of Tertiary age but younger than the Brule. Most wells on the tablelands derive water from the Ogallala Formation alone. Generally, the alluvial deposits are mostly fine grained or thin and capable of yielding only small supplies to wells. Plans for development of irrigation supplies should take into consideration the fact that the groundwater resources will last only 30, 50, 100 years or more, depending on the intensity of the development. Well data, including drillers' logs, are tabulated. Maps, scaled about 2 miles per inch, show potential well yield, top of the Brule Formation, and the configuration and depth of the water table. (Knapp-USGS)
W70-04596

HYDRAULIC TESTING AND SAMPLING OF USBM-AEC COLORADO CORE HOLE 3, RIO BLANCO COUNTY, COLORADO,
Geological Survey, Denver, Colo.
E. H. Cordes.
Geological Survey Open-file Report, December 1969. 42 p, 12 fig, 8 ref.

Descriptors: *Hydrogeology, *Oil shale, *Colorado, *Nuclear explosions, Permeability, Transmissivity, Water pollution sources, On-site tests, Geologic investigations, Water wells, Hydrologic data, Aquifers.
Identifiers: Project bronco, Pumping tests, Aquifer testing.

On November 21, 1967, the U. S. Geological Survey completed the hydraulic testing and sampling of USBM-AEC Colorado Core Hole 3 in Rio Blanco County, Colorado. This hole was drilled to explore the site for Project Bronco, a Plowshare experiment to study the feasibility of in situ retorting of oil shale after breaking the rock with a nuclear explosion. The hydraulic tests indicate the existence of a highly permeable water-bearing zone in the upper and middle parts of the Parachute Creek Member of the Green River Formation. The zone yielded water in excess of 2,700 cubic meters per day. Natural groundwater circulation dissolved the salt deposits from a part of the oil shale, leaving a highly permeable zone. Underlying rocks are comparatively impermeable, and yielded less than 16 cubic meters per day of highly saline fluid. Potential flooding of a rubble chimney is an important consideration for project feasibility and safety. A first approximation of the magnitude of flooding was calculated from the test data. (Knapp-USGS)
W70-04598

RECONNAISSANCE OF THE WATER RESOURCES OF THE FORT SMITH QUADRANGLE, EAST-CENTRAL OKLAHOMA,
Geological Survey, Oklahoma City, Okla.
Melvin V. Marcher.
Oklahoma Geological Survey Hydrologic Atlas 1, 1969. 4 sheets, text, 6 fig, 5 map, 3 tab, 30 ref.

Descriptors: *Water resources, *Groundwater, *Surface waters, *Oklahoma, Water supply, Water wells, Water yield, Aquifers, Geology, Water quality, Streamflow, Precipitation (Atmospheric).
Identifiers: Fort Smith (Okla).

The geology and water resources of the Fort Smith quadrangle, Oklahoma are shown by a 4-sheet hydrological atlas consisting of a geological map, a groundwater availability map, a groundwater quality map, a map showing distribution of precipitation, hydrographs, tabulated data, and descriptive text. In some parts of the Fort Smith quadrangle, wells readily yield several hundred gallons of water per minute suitable for most purposes, whereas in other parts, supplies of water sufficient for daily household use are difficult to obtain and much of this water is of poor quality. Differences in well yield and water quality are controlled mainly by the type of rock in which a well is completed. In general, alluvium is the most favorable type of rock for large well yields, followed by terrace deposits in local areas and then, in order of decreasing favorability, weathered chert, limestone, sandstone, and siltstone, with shale the least favorable. In addition to rock type, geologic structure also affects the occurrence of groundwater, particularly in the northeastern part of the area where springs and some of the wells of larger yield apparently obtain water from rocks broken by faulting. Minor streams in the area go dry or nearly dry almost every year. Alluvium yields groundwater of the best quality and shale to poorest, whereas other rock types yield water with a quality somewhere between. Groundwater that has been in contact with coal beds is usually highly mineralized and, in some places, unfit to drink. Coal mining and oil- and gas-field development may adversely affect the water quality locally. (Knapp-USGS)
W70-04601

BIG BLUE RIVER BASIN.
Nebraska Soil and Water Conservation Commission, Lincoln.
For primary bibliographic entry see Field 02E.
W70-04603

EFFECT OF PULSE RECHARGE ON THE ZONE OF DIFFUSION IN THE BISCAYNE AQUIFER,
Geological Survey, Miami, Fla. Water Resources Div.
F. A. Kohout, and Howard Klein.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 252-270, 1967. 19 p, 14 fig, 8 ref.

Descriptors: *Recharge, *Saline water intrusion, *Groundwater movement, *Aquifers, *Florida, Water quality, Water yield, Discharge (Water), Hydraulic gradient, Water storage, Permiability, Transmissivity, Infiltration.
Identifiers: Miami (Fla), Biscayne aquifer.

In the Biscayne aquifer of the Miami area, Florida, the salt front is dynamically stable at a position as much as 8 miles seaward of that computed according to the Ghyben-Herzberg principle. When the fresh-water head is low, sea water flows inland into the deep part of the aquifer, moves upward, and flows back to the sea through the upper part. The cycle limits the extent to which sea water invades the aquifer. During periods of heavy rainfall large quantities of fresh water are stored below sea level, while deep saline water is driven seaward under steep seaward hydraulic gradient. The effects of these heavy pulses of recharge are demonstrated by biweekly mappings of the isochlor pattern after a 13-inch rainfall. The flow diagrams show that forceful expulsion of salt water after heavy rains results in more efficient recharge than discharge because fresh water is injected into storage throughout the full aquifer thickness, whereas during the subsequent saline intrusion, fresh water is discharged through only about 1/3 of the aquifer thickness. (Knapp-USGS)
W70-04606

ARTIFICIAL FORMATION OF FRESH GROUNDWATER LENSES BY MEANS OF WELLS,
All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
For primary bibliographic entry see Field 04B.
W70-04608

A MATHEMATICAL MODEL OF AN EXISTING MUNICIPAL WELL FIELD,
Oklahoma State Univ., Stillwater.
Richard N. DeVries.
Pap, 1969 Nat Water Well Exposition, Sept-Oct, 1969. 30 p, 3 fig, 15 tab, 6 ref, 4 append.

Descriptors: *Water wells, *Wells, *Mathematical models, Permeability, Operations, *Municipal water, Nebraska, Theis equation, *Model studies, Computer programming, Drawdown, Groundwater recharge, Groundwater flow, Storage coefficient, Pumping, Groundwater mining, *Aquifers.
Identifiers: *Hydrologic models, Groundwater depletion, Pumping tests, Groundwater hydrology, Platte River (Nebr).

Increased irrigation demands on water from the Platte River in central Nebraska are causing a depletion in the flow passing Lincoln's municipal well field at Ashland, Nebr. A study was made for the US Army Engineers, Omaha District, on the future harmful effects of the depletion. A mathematical model using the Theis nonequilibrium equation was formulated. Drawdown computations were performed using a computer. Recharging image wells represented the physical boundary of the aquifer. Drawdowns in selected wells were calculated using the method of superposition by including real wells and image wells. Values for permeability and the storage coefficient were computed from field pumping test data. Three model runs were made. The well field was operable at high rates for periods of greater than 30 days with recharge from the river. Previous studies indicated that the river was the source of most water produced from the wells. The well field can draw on the groundwater reservoir for much longer periods than had been assumed. (USBR)
W70-04619

GEOLOGY AND GROUNDWATER RESOURCES OF LINN COUNTY, KANSAS,
Kansas State Geological Survey, Lawrence.
William J. Seevers.
Kansas Geological Survey Bulletin 193, November 1969. 65 p, 9 fig, 1 plate, 4 tab, 66 ref.

Descriptors: *Water resources, *Groundwater, *Geology, *Kansas, Aquifers, Data collections, Hydrologic data, Hydrogeology, Water wells, Water yield, Water levels, Water quality.
Identifiers: Linn County (Kansas).

Linn County is located along the Kansas-Missouri boundary in east-central Kansas and is a nearly square area of about 605 square miles. Only very small quantities of groundwater are obtained from Pennsylvanian rocks in Linn County. Yields rarely exceed 1 gallon per minute and are normally barely sufficient for domestic purposes. Limestones are the most productive aquifers, and limestones of the lower part of the Kansas City Group are the best of the bedrock aquifers. Groundwater below a depth of about 100 feet in this area is normally too highly mineralized for use. Large quantities (30 to 100 gpm) of good quality water are obtained from properly constructed and developed wells in Il-

linoisan and Wisconsinan valley-fill deposits, mainly from thin gravel deposits near the base. (Knapp-USGS)
W70-04732

THE GROUNDWATER HYDROLOGY OF THE LINCOLNSHIRE LIMESTONE,
Water Resources Board, Reading (England). Groundwater Div.
R. A. Downing, and B. P. J. Williams.
Water Resources Board Publication No 9, Reading, England, 1969. 160 p, 44 fig, 4 plate, 19 tab, 58 ref.

Descriptors: *Hydrogeology, *Aquifers, *Water supply, *Limestones, Hydrology, Transmissivity, Water resources development, Groundwater, Water wells, Artesian wells, Geology, Recharge, Artificial recharge.
Identifiers: Lincolnshire Limestone (England).

The Lincolnshire Limestone, forming part of the Jurassic Inferior Oolite Series of England, is a hard compact limestone incorporating oolitic and pisolitic limestones (which are commonly shelly), calcite mudstones, and locally developed sandy limestones. Both vertical and lateral variations in lithology are ubiquitous. The Limestone thins to the north and south of the Grantham area where the maximum thickness is about 130 ft (40 m). Groundwater flow is mainly through fissures. In South Lincolnshire the water in the Limestone is confined under pressure over a considerable area, and overflowing conditions exist in the low lying ground forming the Fens. High transmissibilities may be due to the solvent action of groundwater moving relatively freely through the aquifer during the Pleistocene period to discharge points in deep channels (now infilled with drift) centered on the Wash. Groundwater in the outcrop zone is of the calcium bicarbonate type, changing gradually to a sodium bicarbonate type and ultimately to a sodium chloride type in a downdip direction. The Limestone is developed extensively for water supply in South Lincolnshire where it is confined by overlying Jurassic strata. The total theoretical resources of the Limestone are estimated to be about 69 mgd; abstraction in 1965 amounted to some 22 mgd. (Knapp-USGS)
W70-04733

THE PRESENT AND FUTURE GROUNDWATER SUPPLY OF THE BATON ROUGE AREA,
Louisiana Water Resources Research Inst., Baton Rouge.
For primary bibliographic entry see Field 04B.
W70-04856

GEOLOGICAL SUBSIDENCE,
Sullivan S. Marsden, Jr., and Stanley N. Davis.
Scientific American, Vol 217, No 6, p 93-100, June 1967.

Descriptors: *Land subsidence, *Injection wells, *Pumping, *Irrigation, *Oil reservoirs, Oil wells, Natural gas, Semiarid climates, Groundwater, California, Subsidence, Damages, Withdrawal, Compaction, Rocks, Structural geology, Instrumentation, Logging (Recording).
Identifiers: *San Joaquin Valley, (Calif).

The pumping of oil, gas or water from the ground often causes the overlying land to sink as porous soil compacts. This phenomenon, known as geological subsidence, was first noted at oil fields near Galveston, Texas, and Long Beach, California. These areas of subsidence are relatively small, however, when compared to the San Joaquin Valley region of California. Sinking has affected areas totalling 2500 square miles there. This is the result of forty years of intensive groundwater pumping for irrigation purposes. In some places the ground is subsiding at the rate of a foot a year and the land is more than 20 feet below its former level. The situation is aggravated by the fact that approximately 20% of all U.S. well water pumping occurs in the San Joaquin Valley. In oil and gas fields the water injection technique is used to prevent soil settling. Further research and investigation is necessary to find methods applicable to water removal areas. (Carr-Arizona)
W70-04908

2G. Water in Soils

FIELD MEASUREMENT OF SATURATED HYDRAULIC CONDUCTIVITY IN INITIALLY UNSATURATED SOIL,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
Herman Bouwer.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 243-251, 1967. 9 p, 3 fig, 12 ref.

Descriptors: *Infiltration, *Measurement, *Soil water movement, *Artificial recharge, *Water spreading, Moisture content, Soil moisture, Hydraulic conductivity, Sorption, Analog models, Model studies, Mathematical models, Hydraulic gradient, Permeameters, Piezometers.
Identifiers: Field hydraulic conductivity tests.

Recent developments for measuring essentially vertical hydraulic conductivity, K, in the zone between soil surface and the water table are discussed. Seepage meters are suitable for measuring K of bottom material (including impedance of clogged surfaces) and local infiltration rates and gradients in spreading basins. A newly developed permeameter-type device enables relatively rapid field measurement of K and the negative soil-water pressure whereby K undergoes its first reduction. The method is applicable to surface and subsurface soil layers and data are obtained for sorption as well as for desorption. Field experiences with the double-tube method are summarized and certain desirable design and operational features are presented. Relatively deep K-measurements can be made by determining infiltration rates and gradients at the bottom of auger holes and wells. Fast-reaching piezometers which enable pressure measurement shortly after insertion were developed for this purpose. A brief discussion is given of how the K-data obtained can be used in analytical, analog, or digital models for predicting total flow systems below spreading basins, including infiltration rates, or transmission losses from ephemeral streams. (Knapp-USGS)
W70-04607

WATER TRANSFER FROM SOIL TO THE ATMOSPHERE AS RELATED TO CLIMATE AND SOIL PROPERTIES,
Texas A and M Univ., College Station. Water Resources Inst.
Charles W. Wendt.
Available from the Clearinghouse as PB-190 268, $3.00 in paper copy, $0.65 in microfiche. Technical Report No 24, Water Resources Institute, Texas A and M University, February 1970. 88 p, 3 tab, 40 fig, 32 ref. OWRR Project A-006-TEX.

Descriptors: *Evaporation, *Soil, *Soil water, *Lysimeters, Vapor diffusion, Unsaturated flow, Microclimate, Water balance, Energy balance.

Lysimeters of 'natural' soil cores were constructed for field study of evaporation. A total of 9 lysimeters were constructed which were designed for either visual or recorded readout of data. Either the combination method of van Bavel or the Bowen Ratio will provide a fair estimate of evaporation from a wet soil surface in the area. In general, the combination method tends to overestimate while the Bowen Ratio tends to underestimate evaporation. This is due to the fact that the combination method places a strong emphasis on this parameter. The conductivity of the Olton loam soil is very low at fairly low soil water pressures corresponding to high contents. This is an asset in preventing evaporation losses, but may be deterimental to crop production in that the crops need to develop extensive root systems to use the stored soil moisture. Evaporation within a cotton crop canopy following rains is related to the net radiation reaching the soil surface. After the surface dries, the moisture content of the soil surface is the limiting parameter. Crude soil applied to the wet soil surfaces of the lysimeters following rains suppressed evaporation immediately following the rains.
W70-04685

MIGRATION OF POLIOVIRUS TYPE 2 IN PERCOLATING WATER THROUGH SELECTED OAHU SOILS,
Hawaii Univ., Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 05G.
W70-04688

A STUDY OF THE EFFECT OF WATER QUALITY AND MANAGEMENT ON PHYSICAL AND CHEMICAL PROPERTIES OF SELECTED SOILS UNDER IRRIGATION,
North Dakota State Univ., Fargo. Dept. of Soils.
For primary bibliographic entry see Field 03C.
W70-04985

2H. Lakes

AN ECOLOGICAL HISTORY OF THE LAKE VICTORIA BASIN,
Duke Univ., Durham, N. C. Dept. of Zoology.
Robert L. Kendall.
Ecological Monographs, Vol 39, No 2, p 121-176, Spring 1969. 56 p, 18 fig, 5 tab, 167 ref, append.

Descriptors: *Ecology, *Lakes, *Paleoclimatology, Quaternary period, Paleohydrology, Paleolimnology, Limnology, Climatology, Vegetation effects, Fish, Water quality.
Identifiers: Lake Victoris (East Africa).

The ecological history of Lake Victoria, east Africa, was studied using historical, sedimentary, chemical, fossil, and pollen data. During the last 12,000 years the overall sedimentation rate has been essentially constant. Lake Victoria was without an outlet from before 14,500 B.P. until about 12,000 B.P. During this time the lake was chemically more concentrated than it is today, and carbonate minerals were precipitated. From 12,000 to 10,000 B.P. the lake probably had an outlet. For a short period around 10,000 B.P. the lake again became closed. Since that time it has drained northward via the Nile River. Changes in forest vegetation are best explained by changes in rainfall, but during the last 3,000 years human forest clearance has interfered. The climatic changes inferred for the northern Victoria basin--dry from 14,500 to 12,000 B.P., moderately wet from 12,500 to 10,500 B.P., moderately dry from 10,500 to 9,500 B.P., wet from 9,500 to 6,500 B.P., and slightly drier or with a more seasonal rainfall after 6,500 B.P.--correlate very well with those already established for montane and rift valley location in east Africa. The greater chemical concentration of Victoria during part of its history may have forced the fish toward the more dilute tributaries, segregating the populations. (Knapp-USGS)
W70-04597

AN INVENTORY OF THE PONDS, LAKES, AND RESERVOIRS OF MASSACHUSETTS-BARNSTABLE COUNTY,
Bureau of Sport Fisheries and Wildlife, Amherst, Mass.
For primary bibliographic entry see Field 07C.
W70-04651

LAKE EUTROPHICATION -- A NATURAL PROCESS,
Geological Survey, Albany, N.Y.

For primary bibliographic entry see Field 05C.
W70-04721

HISTORY OF LAKES ON THE YOUNG-GLACIAL AREAS OF THE NORTH-EASTERN POLAND,
Warsaw Univ. (Poland). Dept. of Physical Geography.
Jadwiga Stasiak.
In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 847-851, 1966. 5 p, 2 fig, 11 ref.

Descriptors: *Lakes, *Lake stages, *Pleistocene epoch, *Paleolimnology, Glacial drift, Ponds, Geomorphology, Limnology, Bogs, Lake basins, Lake beds.
Identifiers: *Poland.

Areas of Poland covered by the last glacier are rich in lakes which were established by melting of blocks of dead, buried ice. The lake age depends upon the thickness of the material covering the ice. The majority of lakes began to appear already in Allerod as shallow, extensive flood waters. In the Holocene, Preboreal and Boreal periods occurred the further formation and deepening of lakes under the influence of ice melting. Some lakes in outwash areas where the thickness of outwash material is considerable, appear only in climatic optima. In the Holocene, there occurred considerable fluctuations of the groundwater table resulting from climatic variations. The fluctuations caused the decay of a great number of smaller basins. (Knapp-USGS)
W70-04754

CHANGES OF THE WATER LEVEL OF LAKE BALATON FROM THE NEOLITHIC AGE UP TO THE PRESENT TIME,
Research Inst. for Water Resources Development, Budapest (Hungary).
L. Bendefy.
In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 852-864, 1966. 13 p, 7 fig, 10 ref.

Descriptors: *Water levels, *Lakes, *Dams, *Spillways, *Regulation, Water level fluctuations, Reservoir operation, Geomorphology, High water mark, Low water mark.
Identifiers: *Lake Balaton (Hungary).

Geomorphology, archeologic evidence, and measurements of past water heights were used with historical records to compile a history of water levels of Lake Balaton, Hungary. The depth in preneolithic times was 106-107 m above Adriatic sea level. Neolithic people built a dam to raise the level to 109 m for defensive purposes. The Romans build a sluice to control the level at 104.5 m. Since that time, the level has been maintained at heights between 107 and 112 m by Hungarians, with high levels in response to invasions and threats of invasions, and low levels for more exposure of farm lands in times of peace. The present level is controlled by a concrete lock at 104.5-105.8 m. (Knapp-USGS)
W70-04755

SOME METHODOLOGICAL PROBLEMS OF INVENTORIES ON LAKES,
Research Inst. for Water Resources Development, Budapest (Hungary).
K. Szesztay.
In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 894-905, 1966. 12 p, 8 fig, 3 tab, 2 ref.

Descriptors: *Lakes, *Surveys, *Statistical methods, Hydrologic data, Hydrologic budget, Data collections, Water resources development, Water management (Applied), Water quality, Water supply, Limnology.
Identifiers: Hungary.

Considering national and international aspects of lake water resources, two kinds of inventories are required: (1) a general survey on all lakes larger than a chosen lower limit, using morphometrical data that can be determined mostly from general geographical maps; (2) an additional survey limited to hydrologically well-studied lakes, containing all basic hydrological data. Results of a detailed national inventory in Hungary show that the number of mapped lakes varies with the chosen lower limit according to a well-defined statistical pattern. As very tentative values for reasonable lower extension limits, 0.5 to 5 hectares can be recommended in case of detailed local surveys, 10 to 50 hectares in case of general countrywide surveys, and 100 to 200 sq km in case of continental or global surveys. The use of the central files comprising inventory results can be facilitated by preparing indexes, maps and diagrams following the viewpoints of various possible application fields. Comparing inventory results with climatological and geomorphological data, general conclusions can be drawn on water balance and stage-regime conditions. (Knapp-USGS)
W70-04757

ON WATER BUDGET LAKE CLASSIFICATION,
Leningrad State Univ. (USSR). Limnology Lab.
B. B. Bogoslovsky.
In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 910-917, 1966. 8 p, 2 fig, 1 tab, 13 ref.

Descriptors: *Limnology, *Lakes, *Surveys, *Classification, Inflow, Streamflow, Water levels, Water supply, Water resources development, Water level fluctuations, Hydrologic budget.
Identifiers: *USSR, Lake classification.

A lake classification is proposed based on the correlation of water budget components. In the USSR, two groups of lakes are based on the correlation of the components of the expenditure part of water budget: (1) 'stokovye' - with outflow predominance; and (2) 'isparjayuschie' - with evaporation predominance. Within every group the lakes are subdivided into types according to the character of the income budget part: 'pritochny' - with the inflow predominance from rivers: 'dohzdevoj' - with atmospheric precipitation predominance to the lake surface and 'neitralny' - with equal quantity of water coming from rivers and atmospheric precipitation. The lake designation in the classification includes the name of the group and the type. Areal distribution of lake types reveals a geographical zonality, both latitudinal and vertical. The lakes of the first type are typical of the zones with high moisture, the lakes of the second type, of arid zones. Water budgets of the lakes with a great drainage basin and a small surface show predominance of inflow and outflow from the lake. The lakes with a large surface and a small drainage basin differ by the predominance of evaporation and atmospheric precipitation. On the basis of the proposed classification a territorial division of lakes of the USSR was performed. (Knapp-USGS)
W70-04758

THE ADAPTATION OF PLANKTON ALGAE. III. WITH SPECIAL CONSIDERATION OF THE IMPORTANCE IN NATURE,
Royal Danish School of Pharmacy, Copenhagen. Dept. of Botany.
E. Steemann Nielsen, and Erik G. Jorgensen.
Physiologia Plantarum, Vol 21, No 3, p 647-654, 1968. 2 tab, 20 ref.

Descriptors: *Plankton, *Algae, Light intensity, Temperature, Primary productivity, Surfaces, Arctic, Enzymes, Chlorophyll, Photosynthesis, Chlorella, Grazing, Zooplankton, Diatoms, Respiration, Pigments, Oceans, Organic matter, Diurnal, Latitudinal studies.
Identifiers: Photooxidation, Chlorella vulgaris, Chlorella vulgaris (Columbia), Chlorella pyrenoidosa, Chlorella saccharophila, Chlorella ellipsoidea, Chlorella luteoviridis, Skeletonema costatum, Physiological adjustment, Asterionella formosa, Cyclotella Meneghiniana, Photic zone, Helsingor (Denmark), Salino-cline.

Adaptation (physiological adjustmant) of plankton algae, in natural states, to different light intensities and temperatures is described. Although different species vary in extent of adaptation, they all adapt to some degree, and adaptation is significant for plankton populations at all depths. Shade adaptation of algae in the lower part of the photic zone is often of minor importance to the integral primary production per unit of surface, except on occasions when the bulk of the algae is found in this lower part. It is shown that the I-sub-k (a light intensity defining onset of light-saturated photosynthesis) of surface plankton during summer in the Arctic is high despite low temperatures due to increase of the enzyme quantities per cell. Daily fluctuations in I-sub-k are partially due to photooxidation and partially because the periods for the production of chlorophyll and photosynthetic enzymes are mutually displaced. Despite daily fluctuations in I-sub-k, the difference between 'sun' and 'shade' phytoplankton is distinct. The diurnal variation in photosynthetic activity of phytoplankton may take place especially at low latitudes, and near the surface; and to some extent at higher latitudes, and in lower photic zone. (Jones-Wisconsin)
W70-04809

EUTROPHICATION TESTING PROGRAM FOR MINNESOTA'S 'SKY BLUE WATERS',
Schoell and Madson, Inc., Hopkins, Minn.
James R. Orr.
Water and Sewage Works, Vol 115, No 3, p 97-101, 1968. 2 fig, 2 tab, 10 ref.

Descriptors: *Eutrophication, *Minnesota, Recreation, Sewage disposal, Water pollution, Pollution abatement, Coliforms, Water quality, Phosphorus, Nitrogen, Flow, Chemical analysis, Nutrients, Effluents, Algae, Weeds, Carbon dioxide, Vitamins, Nitrates, Inorganic compounds, Surface runoff, Underflow, Precipitation (Atmospheric), Drainage, Fertilizers, Farm wastes, Soil erosion, Frozen ground.
Identifiers: Lake Minnetonka (Minn), Minneapolis-St Paul (Minn).

The greatest source of nutrients to Lake Minnetonka, one of Minnesota's best known lakes, is sewage treatment plant effluent. A major part of the problem would be solved by removing nutrients from effluents or suppressing sewage effluent discharge. Loss of large quantities of wastewater outside the watershed could aggravate the problem of maintaining lake level. Another approach may be control of excessive weed and algae production by chemical treatment or mechanical harvesting, however, continued use of algicides may eventually have a toxic effect on fish and other aquatic life; mechanical harvesting is impractical. Advanced waste treatment of sewage discharged to lake, with emphasis on removal of phosphorus should be considered. Miscellaneous nutrient sources, other than sewage plant effluent, represent approximately 2/3 total nitrogen and approximately 1/5 total phosphorus inflow. Watershed dwellers can minimize these sources by preventing decaying vegetation being washed into the lake by rainfall, discontinuing commercial and manure fertilizer usage, and practicing soil erosion control. Municipalities can assist by keeping public lands clean, locating waste dumps to avert drainage into the lake, eliminating soil absorption sewage disposal facilities adjacent to lake, and by publicizing the problem. (Jones-Wisconsin)
W70-04810

SOME OBSERVATIONS OF CURRENTS IN THE HYPOLIMNION OF LAKE MENDOTA,
Wisconsin Univ., Madison. Dept. of Meteorology.
Alison Lathbury, Reid Bryson, and Bernhard Lettau.
Limnology and Oceanography, Vol 5, No 4, p 409-413, 1960. 3 fig, 1 tab, 3 ref.

Descriptors: *Lakes, *Currents (Water), *Hypolimnion, Wisconsin, Thermal stratification, Seiches, Turbulence, Statistical analysis, Hydrography.
Identifiers: *Physical limnology, *Lake Mendota (Wis), 'Free drag' method, Internal seiches, 'Surface' seiches, Hypolimnetic currents, Surface currents, Hydrokinetics.

Data are presented regarding some 2000 current measurements made by 'free drag' method during a ten year period in Lake Mendota, Wisconsin. Frequency distributions of current velocities are presented for 8 depths from entire lake, but predominantly from southwestern portion. Currents at 2-meter depth are anomalous in that their mean and modal velocity exceeds expected values, and that frequency of currents in interval, 0-0.99 centimeters/second, is smaller than expected. Data suggest operation of influences other than usual wind drift mechanism, possibly a larger than expected role for seiche circulation. Deep water currents, particularly in medium-sized stratified lakes, have been thought to result from internal seiches. Seiches in Lake Mendota typically have range of 2-4 millimeters; amplitude, 1-2 millimeters; period, 25-26 minutes; and induced currents, 0.1 centimeter/second at node. Observations of hypolimnetic currents, integrated over 24 hours to include numerous seiche periods, indicate existence of steady motion below thermocline, which are independent of seiches. Best interpretation regards hypolimnetic currents in Lake Mendota as quasi-steady with superimposed seiche-induced variations. Turbulence, also, will not explain observed currents, but problem remains of distinguishing between magnitude of such currents due to thermally induced pressure gradients, and that due directly to wind. (Eichhorn-Wisconsin)
W70-04812

PHOTOSYNTHETIC BEHAVIOUR IN STRATIFIED AND UNSTRATIFIED LAKE POPULATIONS OF A PLANKTONIC DIATOM,
Freshwater Biological Association, Ambleside (England).
J. F. Talling.
Journal of Ecology, Vol 54, p 99-127, 1966. 11 fig, 70 ref.

Descriptors: *Photosynthesis, *Plankton, *Aquatic life, Lakes, Density stratification, Light penetration, Temperature, Depth, Light, Photoperiodism, Oxygen, Aquatic population, Pigments.
Identifiers: *Carotenoids, Chlorophyll a, Photosynthetic mechanism, Photosynthetic-depth profiles, Photoxidation, Asterionella formosa, Windermere Basin (England), Blelham Tarn (England).

Gross photosynthesis rates of four populations of Asterionella formosa were determined from exposures in lakes and laboratory during different seasons of the two successive years. Despite differences between the depth of lakes and timing of population maxima, photosynthetic characteristics and pigments remained similar. Vertical distribution of organisms took place rapidly after thermal stratification. Light was the chief factor in the physiological differentiation in a silica-deficient medium. Deeper cells exhibited a decreased carotenoid:chlorophyll a ratio and contracted chromatophores. No diurnal variation in photosynthetic capacity or pigments was observed. The photosynthesis in populations stratified at different depths could be estimated from the distribution of photosynthetic capacity per unit water volume and the depth-profile rates of photosynthesis of homogenous material. (Wilde-Wisconsin)
W70-04814

INTERACTIONS BETWEEN THE RATES OF PRODUCTION OF A FRESHWATER MACROPHYTE AND PHYTOPLANKTON IN A POND,
Hull Unov. (England). Dept. of Botany.
R. Goulder
Oikos, Vol 20, No 2, p 300-309, 1969. 5 fig, 3 tab, 31 ref.

Descriptors: *Phytoplankton, Productivity, Diurnal, Oxygen, Carbon, Light intensity, Ponds.
Identifiers: *Macrophytes, Ceratophyllum demersum, Potamogeton natans, Vertical distribution, Carbon-14, Carbon fixation, Chlorophyll a, Selenium cell, Northeastern England, England.

As determined by carbon-14 analyses, the annual production of phytoplankton in a small pond of northeastern England constituted 1100 grams carbon/ square meter. The gross annual yield of Ceratophyllum demersum in the same basin, as measured with the diurnal oxygen method, was 600 grams carbon/square meter. The high summer macrophyte productivity followed the maximum spring increment of the phytoplankton. Another pond, with a lesser macrophyte density, had a high summer phytoplankton biomass but its annual production of only 500 grams carbon/square meter, was below that of the first basin. The reason for the summer suppression of phytoplankton in the first pond is attributed to greater shading exerted by Ceratophyllum demersum compared with Potamogeton natans. Phytoplankton yield showed a relationship with the vertical distribution of chlorophyll. (Wilde-Wisconsin)
W70-04818

SHORELAND CORRIDOR REGULATIONS TO PROTECT LAKES,
Wisconsin Univ., Madison.
J. H. Beuscher.
Eutrophication: Causes, Consequences, Correctives, Printing and Publishing Office, National Academy of Sciences, Washington, DC, 1969. p 520-527.

Descriptors: *Lakes, *Eutrophication, *Land use, *Shore protection, *Zoning, *Regulation, Water pollution, Aesthetics, Public Health, Wisconsin, Legislation, Riparian rights, Competing uses, Streams, Flood plain zoning, Wetlands, Planning, Urbanization, Inter-agency cooperation, Legal aspects, Political aspects, Water law, Water policy, Local governments, Public rights, Ethics.
Identifiers: *Cultural eutrophication, Multiple use, Environmental quality, Wisconsin Water Resources Act, Shoreland Protection Ordinance, University of Wisconsin, Model legislation, Public education.

Increasing multipurpose use of lake and stream shorelands has raised diverse and complex problems, not only regarding eutrophication abatement, but also in the areas of public health, aesthetics, and land-use ethics. It is unlikely that normal economic forces will solve shoreland problems; patient educational and voluntary action programs coupled with legal controls are vitally required. Legalistically, shoreland zoning and regulation must consider ownership of lake bottoms, and relative merits of private property versus public interest. Consideration of regulatory impact on private development must include: its effect upon market value of owner's land; damaging effect of development upon others; extent of the public interest and whether regulation meets that need. Research results to document such criteria are often lacking, but groups of specialists, operating as a team, can identify 'indicators of danger' and thus establish a basis for regulation. Based on these principles, a model County Shoreland Protection Ordinance has been developed at University of Wisconsin, Madison, which incorporates following features: zonning controls; subdivision controls; sanitation controls, tree-cutting restrictions; controls on filling, grading, and creating artificial waterways. A list of requirements for future success of such programs is included. (See Vol. 3, No. 10, Field 5C, W70-03975). (Eichhorn-Wisconsin)
W70-04820

PRODUCTIVITY OF PHYTOPLANKTON AND QUANTITIES OF ZOOPLANKTON AND BOTTOM FAUNA IN RELATION TO WATER QUALITY OF LAKE ASHTABULA RESERVOIR, NORTH DAKOTA,
North Dakota State Univ., Fargo. Div. of Natural Sciences.
J. J. Peterka.
Available from the Clearinghouse as PB-190 356, $3.00 in paper copy, $0.65 in microfiche. Research Project Technical Completion Report, North Dakota, Feb 1970. OWRR Project A-011-NDAK.

Descriptors: *Water chemistry, Reservoirs, *Phytoplankton, *Zooplankton, Benthic invertebrates, Primary and secondary productivity, Ecology, North Dakota eutrophication, Limnology.
Identifiers: Lake Ashtabula Reservoir.

Lake Ashtabula, a 5,430-acre reservoir in southeastern North Dakota, was found to be a highly productive impoundment. Chemical, physical, and plankton samples were taken in 1967-68; benthic invertebrates in 1967. Largest chemical exchanges occurred from February-June when large water volumes also entered and left the reservoir. Large amounts of phosphates, inorganic nitrogen and total iron entered during March. Phosphates, total iron and total alkalinity were retained in the reservoir from June 1967 to June 1968, whereas sulfates decreased. The order of appearance of maximum numbers of zooplankton was similar in 1967-68 with Cyclopoida first, then Daphnia pulex, Asplanchna, Diaptomus, Daphnia galeata mendotae, Bosmina, Cereodaphnia, Chydorus, and a fall pulse of D. pulex. Chaoborus was found only in 1967; Leptodora in 1968. Daphnia comprised 84% of total zooplankton dry weight standing crop in 1967 and 81% in 1968; copepods 14% in 1967 and 17% in 1968. The average dry weight daily standing crop of D. pulex was 1110 in 1967 and 2851 mg/ (sq m) in 1968; of D. g. mendotae was 294 in 1967 and 7.2 mg/ (sq m) in 1968. Daphnia annual net production averaged 113.1 and 71.3 mg/ (sq m)/sq day in 1967 and 1968, respectively; its calculated turnover time from January-December was 11.8 days for 1967 and 40.0 days for 1968. In both years, plytoplankton at Station 2 included a March-June pulse of largely nannoplankton diatoms, Stephanodiscus spp., and Cyclotella spp., followed by microplankton Stephanodiscus niagarae, Asterionella formosa and Cryptomonas spp. from June-July. Aphanizomenon holsaticum dominated from July-November. In 1967 and 1968, respectively, Aphanizomenon comprised 86.3 and 92.9%, diatoms 13.4 and 2.97%, and other phytoplankters 0.3 and 4.2% of total algal weight from January-December. At Station 2 from January-December 1967 and 1968, the average daily algal weight standing crop was 176.5 and 288.6 g/ (sq m), and average daily gross photosynthesis was 4.10 and 6.75 O2/ (sq m)/day, respectively. From March-November 1968, 1.0 microgram chlorophyll 'a' = 1.0 cu mm algal cells. The correlation coefficient of silicon with loge total diatom numbers from 3 June-20 October 1968 was $r = 0.51$ ($P = 0.05$). The average standing crop of benthic invertebrates at Station 2 from April-August 1967 was 2,483 individuals weighing 10.9 g/ (sq m), with 52% by number and 76% by weight found in the 0-3 m depth zone; 42% by number and 21% by weight in 3-8 m; and 6% by number and 3% by weight in the 8-12 m depth zone.
W70-04855

HISTORY OF THE DEVELOPMENT OF LAKE ISSYK-KUL. (IN FRENCH),
Moscow State Univ. (USSR).
Z. V. Aleuchinskaya, L. G. Bobdarev, and R. D. Zabirov.
In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 841-846, 1966. 6 p, 2 fig, 12 ref.

Descriptors: *Lakes, *Paleolimnology, Geomorphology, Water quality, Depth, Productivity, Ecology, Pleistocene epoch, Lake morphology, Lake stages, Water levels.
Identifiers: *USSR, Lake Issyk-Kul, Paleontology.

The history of the origin and development of Lake Issyk-Kul, one of the largest lakes in the Soviet Union, is described. When solving problems of paleolimnology, geological-geomorphological,

geochemical, paleontological, and isotopic methods were used. The investigations described a complicated history of the Lake Issyk-Kul and repeated fluctuations of its level, mainly due to climatic changes. (Knapp-USGS)
W70-05021

THE IJSSEL LAKE AS A MULTI-PURPOSE RESERVOIR,
Zuider Zee Works (Netherlands). Hydrology Section.
For primary bibliographic entry see Field 08A.
W70-05027

2I. Water in Plants

RELATION OF SNOWPACK ACCUMULATION TO RED PINE STOCKING,
Forest Service (USDA), Cadillac, Mich. North Central Forest Experiment Station.
For primary bibliographic entry see Field 02C.
W70-04717

PLANKTON DIATOM ASSEMBLANCES IN LAKE MICHIGAN,
Michigan Univ., Ann Arbor.
For primary bibliographic entry see Field 05C.
W70-04902

EFFECT OF DROUGHT UPON RATES OF PHOTOSYNTHESIS, RESPIRATION, AND TRANSPIRATION OF SEEDLINGS OF TWO ECOTYPES OF DOUGLAS-FIR,
Oregon State Univ., Corvallis. School of Forestry; and Oregon Agricultural Experiment Station, Corvallis.
J. Zavitkovski, and W. K. Ferrell.
Botanical Gazette, Vol 129, No 4, p 346-350, December 1968. 3 fig, 1 tab, 19 ref. NSF Grant G-9576.

Descriptors: *Drought resistance, *Douglas fir trees, *Respiration, *Transpiration, *Photosynthesis, Turgidity, Droughts, Arid lands, Moisture stress, Plant physiology, Environment, Seeds, Soil moisture, Soil-water-plant relationships, Moisture tension.
Identifiers: *Seedlings.

Douglas-fir seedlings were grown from seed collected at two sites of widely differing habitat. One group of seed was gathered from an area of high precipitation but limited summer rain, the other from a dry area with a prolonged summer drought. Rates of respiration, transpiration, and photosynthesis were determined under variable soil-moisture stress conditions. After 1 atm of stress was reached photosynthetic rates declined sharply. Mesic site seedlings had higher respiration and transpiration rates at both high and low soil moisture tensions. Seedlings from the drier environment had higher rates of photosynthesis at high relative turgidities and lower rates at low relative turgidities than seedlings from the wetter site. Relative turgidity of xerophytic seedlings varied less than that of mesophytic seedlings over a wide range of soil-moisture tensions. It appears that seedlings from the xeric site have adapted to the severe drought conditions of their arid environment. (Carr-Arizona)
W70-04909

DIURNAL VARIATION IN LEAF AND BOLL TEMPERATURES OF IRRIGATED COTTON GROWN UNDER TWO SOIL MOISTURE REGIMES IN A SEMI-ARID CLIMATE,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Irrigation Research Lab.
J. H. Palmer.
Agricultural Meteorology, Vol 4, No 1, p 39-54, January 1967. 7 fig, 2 tab, 20 ref.

Descriptors: *Cotton, *Irrigation effects, *Crop response, *Moisture stress, *Diurnal, Fluctuation, Biorhythms, Plant physiology, Air temperature, Semiarid climates, Soil-water-plant relationships, Thermal stress, Temperature, Leaves, Soil moisture, Furrow irrigation, Canopy, Measurement, Summer, Winter.
Identifiers: *Leaf temperature, *Boll temperature, *Australia, Thermocouples.

Cotton plants under furrow irrigation were studied to determine the effect of withholding irrigation water upon leaf and boll temperature. In all of the experiments the leaf temperature of irrigated plants tended to level off toward the end of the morning, but the temperature of non-irrigated plants continued to increase at the early morning rate. For both moisture regimes, the plants cooled rapidly following midafternoon and were cooler than the ambient air by early evening. In a comparison of irrigated and non-irrigated plants, it appeared that boll temperature is more sensitive than leaf temperature to soil moisture stress. (Carr-Arizona)
W70-04912

2J. Erosion and Sedimentation

SUSPENDED MATTER IN SURFACE WATERS OF THE ATLANTIC CONTINENTAL MARGIN FROM CAPE COD TO THE FLORIDA KEYS,
Woods Hole Oceanographic Institution, Mass; and Williams Coll., Williamstown, Mass. Dept. of Geology.
Frank T. Manheim, Robert H. Meade, and Gerard C. Bond.
Science, Vol 167, p 371-376, January 1970. 6 p, 4 fig, 3 tab, 24 ref.

Descriptors: *Suspended load, *Sea water, *Atlantic coastal plain, *Water pollution sources, Surveys, Sampling, Currents (Water), Ocean currents, Sediment distribution, Sediment load.
Identifiers: Atlantic continental margin.

Appreciable amounts of suspended matter over 1.0 milligram per liter in surface waters are restricted to within a few kilometers of the Atlantic coast. Particles that escape estuaries or are discharged by rivers into the shelf region tend to travel longshoreward rather than seaward. Suspended matter farther offshore, chiefly amorphous organic particles, totals 0.1 milligram per liter or less. Soot, fly ash, processed cellulose, and other pollutants are widespread. (Knapp-USGS)
W70-04552

SOIL EROSION IN THE DETROIT METROPOLITAN AREA,
Soil Conservation Service, East Lansing, Mich.
J. R. Thompson.
Journal of Soil and Water Conservation, Vol 25, No 1, p 8-10, January-February 1970. 3 p, 3 fig, 4 tab, 4 ref.

Descriptors: *Soil erosion, *Urbanization, *Michigan, Cities, Runoff, Soil conservation, Land use, Roads, Sediment yield, Construction, Road construction, Sediment control.
Identifiers: Detroit (Mich).

A study was made in the Detroit metropolitan area to evaluate the rates and amounts of erosion from urban construction sites. In the summer of 1968, 2.1% of an urban zone was under development. This zone produced about the same amount of eroded soil material as the remaining 97.9% of the area. Erosion from the developing areas averaged 69 tons per acre per year, compared with an overall average erosion rate for the metropolitan area of about 3.0 tons per acre per year and an overall average erosion rate for southeast Michigan of 2.6 tons per acre per year. (Knapp-USGS)
W70-04557

TOTAL SEDIMENT DISCHARGE OF SELECTED STREAMS IN KANSAS, 1957-65, A COMPILATION,
Geological Survey, Lawrence, Kans.
C. D. Albert.
Kansas Water Resources Board Bulletin No 10, June 1969. 8 p, 1 fig, 1 tab, 8 ref.

Descriptors: *Sediment load, *Streams, *Kansas, *Sediment discharge, Sediment transport, Bed load, Suspended load, Discharge (Water), Streamflow, Particle size, Data collections, Hydrologic data.
Identifiers: Sediment sampling.

Computed total sediment discharges for selected streams in Kansas are presented. The suspended load is computed from analyses of depth-integrated samples, but the design of the suspended-sediment sampling equipment prevents sampling within about 0.3 foot of the stream bottom. In a sand-bed stream the sediment concentration normally is higher and the particle size larger in the unsampled zone than in the sampled zone. Thus, the total sediment discharge of many streams may be appreciably greater than that indicated by suspended-sediment samples alone. Several different formulas and procedures have been used to determine the total sediment discharge of streams. A procedure developed by H. A. Einstein (1950) was modified by Colby and Hembree (1955) and was simplified again by Colby and Hubbell (1961). The latter modification, which includes graphical methods to eliminate cumbersome computations, was used to obtain the results shown in the data tabulation. (Knapp-USGS)
W70-04560

THE EFFECT OF STRONG STORMS ON SAND BEACHES OF THE BALTIC EASTERN SHORE,
Akademiya Nauk SSSR. Institut Okeanologii.
For primary bibliographic entry see Field 02L.
W70-04566

MECHANICS OF THE SUCCESSIVE SALTATION OF A SAND PARTICLE ON A GRANULAR BED IN A TURBULENT STREAM,
Kyoto Univ., (Japan). Disasters Prevention Research Inst.
Yoshito Tsuchiya.
Bulletin Disaster Prevention Research Institute, Vol 19, Part 1, Paper 152, p 31-44, August 1969. 14 p, 8 fig, 1 photo, 10 ref.

Descriptors: *Erosion, *Sediment transport, *Sands, *Saltation, Alluvial channels, Turbulent flow, Streamflow, Mathematical studies, Mathematical models.
Identifiers: Movable beds.

Most of the saltating sand particles on a granular bed in a turbulent stream successively continue saltation after initial motion. In this paper, such a saltation motion is defined as successive saltation. A theory of the successive saltation of a single sand particle on a granular bed is proposed on the basis of the equation of motion for saltation and the dynamic characteristics of collision between a saltating sand particle and bed sand particles. The theoretical relationships for the saltation height and distance and for their distribution characteristics are in good agreement with the results of experiments. (Knapp-USGS)
W70-04582

FIELD MEASUREMENT OF THE INITIATION OF LARGE BED PARTICLE MOTION IN BLUE CREEK NEAR KLAMATH, CALIFORNIA,
Geological Survey, Washington, D.C.
E. J. Helley.
Report available for sale by Superintendent of Documents, U S Government Printing Office, Washington, D C 20402 - Price 35 cents. Geological Survey Professional Paper 562-G, p G1-G19, 1969. 19 p, 15 fig, 2 tab, 26 ref.

Descriptors: *Sediment transport, *Bed load, *Alluvial channels, Hydraulics, Movement, Scour, Erosion, Tractive forces, Velocity, Streamflow, Sedimentation.
Identifiers: Particle movement initiation.

In a field sediment transport study, more than two-thirds of measurements of bed velocity necessary to initiate motion of coarse natural particles agree within 20% of those velocities predicted from theory. The theory is based on balancing turning moments of the fluid forces of drag and lift with the resisting moment of the submerged particle weight. Initial motion seems to depend more on size and shape than on specific gravity or orientation angle. In fact, shape differences almost completely compensate for differences in specific gravity from 2.65-3.00 and at orientation angles from 0 deg-25 deg. Bed velocities necessary to initiate motion of coarse bed material in Blue Creek are equaled or exceeded about 5% of the time. This fact and changes in channel topography and cross-sectional area emphasize the ability of perennial mountain streams to transport coarse bed material frequently. (Knapp-USGS)
W70-04599

TIDAL VARIATION OF THE SUSPENDED SEDIMENT SIZE DISTRIBUTION AT A STATION IN UPPER CHESAPEAKE BAY,
Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
For primary bibliographic entry see Field 02L.
W70-04696

ATMOSPHERIC DUSTS FROM THE NORTH PACIFIC - A SHORT NOTE ON A LONG-RANGE EOLIAN TRANSPORT,
Marathon Oil Co., Littleton, Colo.; and Scripps Institution of Oceanography, La Jolla, Calif.
For primary bibliographic entry see Field 05B.
W70-04707

A NEW METHOD TO DETERMINE THE SPHERICITY OF MOBILE SEDIMENTS,
Centre Universitaire Marseille-Luminy, Marseille (France). Geology Lab.
Pierre Weydert.
Sedimentology, Vol 13, No 1-2, p 71-83, October 1969. 13 p, 5 fig, 4 tab, 17 ref.

Descriptors: *Particle shape, *Sediments, *Analytical techniques, *Sieves, *Sieve analysis, Instrumentation, Separation techniques, Measurement, Sedimentology, Statistical methods, Sampling.
Identifiers: Particle shape analysis, Sphericity, Roundness.

A new method is presented to determine the sphericity of sand particles with sedimentary analysis. Two different sieves are used: one with open squares; the other with circular openings. Experimentation shows that particles crossed the open-square sieves in diagonal positions. A sediment, which is composed of subspherical particles, is represented by two cumulative curves on the same graph. If the sediment is very angular, the two curves are disconcerted, while if the sediment is subspherical, the difference between the two curves is maximum. The sphericity values obtained are comparable with those of visual charts. (Knapp-USGS)
W70-04731

DETERMINATION OF SILTING IN WATER BASIN BY MEANS OF SOLID TRANSPORT BALANCE, (IN FRENCH),
State Inst. of Hydrology and Meteorology, Krakow (Poland).
J. Cyberski.
English summary included. In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 741-746, 1966. 6 p, 2 fig, 8 ref. English summary included.

Descriptors: *Reservoir silting, *Forecasting, *Sedimentation, Bed load, Suspended load, Provenance, Sediment yield, Silts, Erosion, Sediment transport.
Identifiers: *Poland, Dunajec River.

A method to determine the silting of reservoirs is presented and applied to the Roznow Reservoir, Poland. The method is based on many years of observations and measurements of water stage, discharge and silt charge of the Dunajec River, as well as special research on the damage of the shores, and the bed load coming from small streams. The main sources of sediment supplying the reservoir are the suspended and bed loads of the Dunajec River and of the small streams flowing into the reservoir. In the total amount of the silting the participation of the solid transport from individual sources is variable. The basic component is the suspended load of the Dunajec River; a small percentage is due to the bed load from the streams flowing into the reservoir and the bed load coming from Dunajec river. Only 1 percent originates in the bed load from the shore denudation. (Knapp-USGS)
W70-04751

EVALUATION OF FACTORS AFFECTING RESERVOIR SEDIMENT DEPOSITION,
Corps of Engineers, Rock Island, Ill., Iowa Univ., Ames, and Argicultural Research Service, Columbia, Mo.
C. W. Farnham, C. E. Beer, and H. G. Heinemann.
In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 747-758, 1966. 12 p, 2 fig, 2 tab, 13 ref.

Descriptors: *Reservoir silting, *Forecasting, *Sedimentation, *Statistical methods, Regression analysis, Iowa, Missouri, Erosion, Sediment transport, Land management, Provenance, Loess, Missouri River.
Identifiers: *Missouri River basin.

Detailed field surveys were made of existing reservoirs in the loessial hills of western Iowa and northwestern Missouri to determine the rate of sediment accumulation. Additional data were secured to evaluate the variables associated with reservoir trap efficiency, with delivery of sediment to reservoir and with gross erosion from the contributing watershed area. Through the use of multiple regression techniques, the rate of sediment deposition in the reservoirs was expressed as a function of computer gross erosion and measured reservoir and watershed variables. The results show that the amount of sediment deposited in the reservoir is highly correlated with the computed gross erosion. The remaining variation was explained as a function of variables defining the reservoir trap efficiency and watershed delivery ratio. A greater insight was obtained of the importance of land management and the interaction of reservoir and watershed variables as they affect reservoir sedimentation. (Knapp-USGS)
W70-04752

SEDIMENTATION IN A SMALL CHANNEL-TYPE RESERVOIR,
Agricultural Research Service, Columbia, Mo. Soil and Water Conservation Div., and Missouri Univ., Columbia. Dept. of Zoology.
H. G. Heinemann, D. L. Rausch, and R. S. Campbell.
In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 769-779, 1966. 11 p, 5 fig, 1 tab, 9 ref.

Descriptors: *Reservoir silting, *Forecasting, *Sedimentation, *Surveys, Water quality, Thermal stratification, Silts, Clays, Model studies, Water circulation, Sediment transport, Particle size, Solutes, Provenance, Reservoir design.
Identifiers: *Ashland Lake (Missouri), Channel reservoirs.

Ashland Lake in central Missouri is a channel-type reservoir that was built in 1937 with a capacity of about 346,000 cubic meters. Its drainage area is 979 hectares. A study of its sedimentation was undertaken to provide essential design information. Detailed reservoir sedimentation surveys were made in 1949, 1951, 1955 and 1962. The distribution of sediment in the vertical and in the horizontal planes remained fairly constant between surveys. The particle-size distribution of the deposited sediment was found to vary, depending on the distance from the dam. The volume-weight of the sediment increased with depth in the deposit and decreased with percent clay. Physical and chemical measurements of the lake water show that Ashland Lake is stratified thermally May through October, confining circulation to the upper one-third of the lake. Water turbidity may reach 200 ppm (platinum wire). Concentrations of cations are less than amounts considered effective in flocculation of clay particles. (Knapp-USGS)
W70-04753

LAYERED SEDIMENTS OF TIDAL FLATS, BEACHES, AND SHELF BOTTOMS OF THE NORTH SEA,
Research Inst. for Geology and Biology. Wilhelmshaven (West Germany).
H. E. Reineck.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 191-206, 1967. 16 p, 32 fig, 3 tab, 43 ref.

Descriptors: *Sedimentary structures, *Sediments, *Beaches, *Mud flats, Continental shelf, Sedimentation rates, Provenance, Ripple marks, Sand waves, Sedimentation, Sands, Clays, Marshes.
Identifiers: *North Sea, Laminated sand, Ripple bedding, Lenticular bedding, Laminated bedding, Salt marsh.

Deposits of a particular environment are influenced by the type of available sediments, physical processes and their intensity, rate of sedimentation, and biogenetic factors. Sedimentary structures show the nature of water movement. For example, horizontal silty-clay lamellae are found in areas with little water movement whereas cross-bedded sands are a result of greater water movement. The characteristics of the following sedimentary structures are discussed and illustrated: (1) laminated sand; (2) ripple bedding; (3) lenticular bedding; (4) fine rhythmically laminated bedding; (5) coarse rhythmically laminated bedding; (6) mud deposits; (7) salt marsh or flood deposits; and (8) bioturbate structures. The distribution of sedimentary structures on salt marsh, tidal flat, sand flat, shore area and inshore to shelf area is given. (Carstea-USGS)
W70-04994

THE ONTOGENY OF A SALT MARSH ESTUARY,
Woods Hole Oceanographic Institution, Mass.
For primary bibliographic entry see Field 02L.
W70-04998

EPHEMERAL ESTUARIES OF THE DELTAIC ENVIRONMENT,
Louisiana State Univ., Baton Rouge. Coastal Studies Inst.
For primary bibliographic entry see Field 02L.
W70-05000

REGIONAL GEOMORPHOLOGICAL CHARACTERISTICS OF SOME AUSTRALIAN ESTUARIES,
Australian National Univ. (Canberra).
For primary bibliographic entry see Field 02L.
W70-05001

SEDIMENTS OF YAQUINA BAY, OREGON,
Oregon State Univ., Corvallis. Dept. of Oceanography.
L. D. Kulm, and John V. Byrne.

In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 226-238, 1967. 13 p, 12 fig, 13 ref. ONR Contract Nonr 1286 (10).

Descriptors: *Sediments, *Sedimentation, *Oregon, *Bays, Estuaries, Deposition (Sediments), Minerology, Particle size, Provenance, Sands, Sediment transport, Beaches, Mixing, Salinity, Shoals, Dredging, Sedimentation rates.
Identifiers: Yaquina Bay (Oregon).

Marine, fluviatile and marine-fluviatile deposition were defined in Yaquina Bay on the basis of sediment texture and mineralogy. Seasonal sedimentation, sources of recent sediments, and transport of marine sand from adjacent ocean beaches are described. Quantitative information about salinity mixing, shoaling, rates of deposition, source of shoaling material, and effects of improvement works on sediment deposition along the adjacent ocean beaches is given. Known areas of shoaling occur on the bar, in the main channel, and in the turning basin. Estimated average rate of deposition in the dredged channel is 9 inches per year. (Carstea-USGS)
W70-05002

THE SEDIMENTS OF CHESAPEAKE BAY,
Maryland Univ., Solomons. Natural Resources Inst.
Robert B. Biggs.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 239-260, 1967. 22 p, 26 fig, 8 tab, 49 ref.

Descriptors: *Sediments, *Sedimentation, *Water quality, *Bays, Water chemistry, Mineralogy, Clay minerals, Acidity, Color, Mixing, Oxidation, Reduction potential, Oxygen, Organic matter, Iron, Sulfur compounds.
Identifiers: *Chesapeake Bay, Pore water analysis, Sediment-water relationships.

Data from geological and oceanographic investigations of Chesapeake Bay show correlations between sediment types and dominating influences. A typical sequence of measured parameters and major influences of these parameters, both in the water column and the sediment, are presented. The parameters observed were pH, oxygen concentration, sulfate concentration, and Eh in the water column and pore water of the bed sediments. The color and water content of the sediments are also discussed. These parameters were related to the influences of mixing, oxidation, reduction, biological and bacterial activity, hydrotroilite concentration, and state of organic matter, iron, and sulfur species. (Carstea-USGS)
W70-05005

CONTRASTS IN COASTAL BAY SEDIMENTS ON THE GULF AND PACIFIC OCASTS,
University of Southern California, Los Angeles. Dept. of Geological Sciences.
D. S. Gorsline.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 219-225, 1967. 7 p, 43 ref.

Descriptors: *Bays, *Coasts, *Sediments, *Sedimentation, *Estuaries, Lagoons, Sands, Beaches, Water circulation, Currents (Water), Tidal waters, Topography.
Identifiers: *Estuarine sedimentation, High-energy coasts, Low-energy coasts.

The general features of estuaries, estuarine sedimentation and sediment properties are discussed. Estuaries, bays, and lagoons are relatively new physical products and their age is not more than 3000 years. The major component of sediments in sand, and sedimentation patterns in these bodies of water are controlled by bottom topography and circulation. On high-energy coasts, estuaries are separated from the open sea by spits or beach deposits, and on low-and medium-energy coasts, estuaries are associated with coastal lagoons and barrier islands. Tidal currents are mainly responsible for circulation patterns in estuaries. The bulk of the sediment in estuaries is derived from seaward or coastal sources. Estuarine and bay sediments are relatively thin. (Carstea-USGS)
W70-05007

SEDIMENTARY PATTERNS OF MICROFAUNA IN A COASTAL PLAIN ESTUARY,
Virginia Inst. of Marine Science, Gloucester Point; and Virginia Univ., Charlottesville. Dept. of Geology.
For primary bibliographic entry see Field 02L.
W70-05009

COMPARISON OF RECENT AND ANCIENT TIDAL FLAT AND ESTUARINE SEDIMENTS,
Pennsylvania Univ., Philadelphia. Dept. of Geology.
George De Vries Klein.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 207-218, 1967. 12 p, 7 fig, 63 ref.

Descriptors: *Estuaries, *Sediments, Mud flats, Sedimentation, Marshes, Water circulation, Shallow water, Channels, Sedimentary structures, Barriers, Clays.
Identifiers: Tidal flat sedimentation.

Recent tidal flat sediments and sedimentation are described for Wadden-type flats and Fundy-type tidal flats. In the Wadden type, sedimentation occurs along soft-sediment coasts, whereas in the Fundy type it occurs along bedrock coasts. Geographic interrelationships are summarized for the following sedimentary environments in Wadden-type flats: salt marshes, high tidal flats, low tidal flats, and tidal channels. In Fundy-type flats, the following major sedimentary environments are discussed: Wave cut benches, estuarine clay flats, tidal flats in the lee of barrier islands, and tidal marshes. Ancient tidal flat deposits are described from the upper devonian of Belgium, the lower Devonian of England, and the Pennsylvanian of Illinois. Deposition of evaporites in the geological past required an estuarine circulation system and; therefore, it took place in mixed shallow marine environments. (Carstea-USGS)
W70-05010

QUANTITATIVE RESEARCH ON LITTORAL DRIFT AND TIDAL INLETS,
Florida Univ., Gainesville. Coastal Engineering Lab.
For primary bibliographic entry see Field 02L.
W70-05011

RATES OF SEDIMENT ACCUMULATION IN MODERN ESTUARIES,
Miami Univ., Fla. Inst. of Marine Science.
For primary bibliographic entry see Field 02L.
W70-05012

ORIGIN OF SEDIMENTS IN ESTUARIES,
Paris Univ. (France). Institut de Geographie.
For primary bibliographic entry see Field 02L.
W70-05013

ESTUARIES AND LAGOONS IN RELATION TO CONTINENTAL SHELVES,
Woods Hole Oceanographic Institution, Mass.
For primary bibliographic entry see Field 02L.
W70-05016

SEDIMENT TRANSPORT AND SEDIMENTATION IN THE ESTUARINE ENVIRONMENT,
Netherlands Inst. for Sea Research, Den Helder.
For primary bibliographic entry see Field 02L.
W70-05018

BANK FORMATION OF NEWLY ESTABLISHED RESERVOIRS,
State Hydrological Inst. (USSR).
For primary bibliographic entry see Field 04A.
W70-05022

BEHAVIOR OF CHANNELS UPSTREAM FROM RESERVOIRS,
Geological Survey, Tucson, Ariz.
For primary bibliographic entry see Field 02E.
W70-05023

SOME VARIABLES WHICH INFLUENCE RATES OF RESERVOIR SEDIMENTATION IN WESTERN UNITED STATES,
Soil Conservation Service, Portland, Oreg. Engineering and Watershed Planning Unit.
Elliott M. Flaxman.
French resume included. In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 824-838, 1966. 15 p, 4 fig, 3 tab, 4 ref.

Descriptors: *Reservoir silting, *Reservoir design, *Sediment transport, *Provenance, Statistical methods, Regression analysis, Aggradation, Runoff, Vegetation effects, Erosion, Rainfall-runoff relationships, Topography, Rainfall intensity.
Identifiers: *Sediment storage, Western U.S.

Predictions of sediment storage requirements are needed in the design of flood detention and water supply reservoirs in order to sustain an adequate capacity for intended purposes. In western United States the wide range in geologic, topographic, climatic, soils and vegetative conditions includes a number of factors which operate to increase or decrease rates of sediment deposition. To determine the influence of some watershed and reservoir variables on this problem, statistical procedures were used to analyze data from 30 locations in 9 states. Multiple regression and principal component regression with varimax rotation of the factor weight matrix were used. Variables include expressions for runoff, related vegetative response, rainfall intensity, topography, soil characteristics, the density of deposits, and trap efficiency of the reservoirs. The results of the analysis and predictive equations for sedimentation rates and for density of reservoir deposits are given. (Knapp-USGS)
W70-05024

SEDIMENT DESIGN REQUIREMENT FOR SMALL RESERVOIRS,
Soil Conservation Service, Washington, D.C. Engineering Div.
John W. Roehl.
French resume included. In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 795-803, 1966. 9 p, 3 fig, 9 ref.

Descriptors: *Reservoir silting, *Farm ponds, *Reservoir design, Sediment yield, Sediment transport, Reservoir yield, Erosion, Runoff, Soil conservation, Soil erosion, Land management.
Identifiers: Soil Conservation Service.

The Soil Conservation Service, through the Watershed Protection Program, designs and constructs several hundreds of small floodwater retarding and multiple-purpose structures each year. A procedure has been developed for humid areas that provides the information concerning the sedimentation aspects required for the design of these structures. Involved in this procedure are quantitative estimates of erosion occurring in the drainage areas, the resultant sediment yields, the trap efficiency of the reservoir, and the volume weight and distribution of the deposited sediment within the reservoir. The success of the sediment design procedure is illustrated by comparisons of the computed requirements and the measured accumulation in selected reservoirs. (Knapp-USGS)
W70-05025

2K. Chemical Processes

CHEMISTRY OF MANGANESE IN NATURAL WATERS,
Soil Research Labs., Amritsar (India).
B. K. Handa.
Chemical Geology, Vol 5, No 3, p 161-165, January 1970. 5 p, 1 fig, 2 tab, 6 ref.

Descriptors: *Water chemistry, *Manganese, *Chemical precipitation, Calcium carbonate, Groundwater, Oxidation, Chemical reactions, Geochemistry, Trace elements.
Identifiers: Manganese complex ions.

In natural waters, manganese salts are much more stable than the corresponding iron salts. While the precipitation of iron was found to be complete within 48 hours from the time of collection of the water sample, generally only a small fraction of the total manganese had precipitated in about a week's time. However, once the precipitation starts, the process becomes relatively more rapid, perhaps due to autocatalysis. Even when precipitation of calcium carbonate occurs, some manganese may still remain in solution. (Knapp-USGS)
W70-04558

DETERMINATION OF SELENIUM BY THE RING OVEN TECHNIQUE,
Missouri Univ., Kansas City. Dept. of Chemistry.
For primary bibliographic entry see Field 07B.
W70-04561

TRACE METALS IN WATERS OF THE UNITED STATES, OCTOBER 1, 1962-SEPTEMBER 30, 1967,
Federal Water Pollution Control Administration, Cincinnati, Ohio. Div. of Pollution Surveillance.
For primary bibliographic entry see Field 05A.
W70-04567

THE MINERALOGICAL COMPOSITION OF SUSPENDED MATTER IN THE INDIAN OCEAN,
Akademiya Nauk SSSR. Institut Okeanologii.
For primary bibliographic entry see Field 02L.
W70-04568

COMPOSITION AND ORIGIN OF IRON-ORE SEDIMENTS AND HOT BRINES IN THE RED SEA,
Akademiya Nauk SSSR. Institut Okeanologii.
G. N. Baturin, A. V. Kochenov, and Ye. S. Trimonis.
Transl from Okeanologiya, Akad Nauk SSSR, Moscow, Vol 9, No 3. Oceanology, Vol 9, No 3, p 360-368, 1969. 9 p, 2 fig, 8 tab, 28 ref.

Descriptors: *Brines, *Saline water, *Iron oxides, *Bottom sediments, Oceanography, Water chemistry, Mineralogy, Water temperature, Chemical precipitation, Salts.
Identifiers: Red Sea, Iron deposits.

The hot brines in depressions of the central Red Sea contain thousands of times more iron, manganese and other nonferrous metals than the sea water. After removal of salts, approximately half of the sediments of these depressions consists of iron hydroxides and they are enriched with zinc, copper, lead and molybdenum. Hydrothermal deposits with the same complex of metals, located along the coast of the Red Sea, are correlated with faults and may be due to occurrences of Tertiary volcanism. Brines of similar composition to those in the Red Sea are known in the Cheleken Peninsula. Geological and geochemical data indicate that such brines are of relatively deep origin. (Knapp-USGS)
W70-04569

FORMATION OF BRINES IN BOTTOM DEPRESSIONS OF THE RED SEA,
All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
S. I. Smirnov.
Transl from Okeanologiya, Akad Nauk SSSR, Moscow, Vol 9, No 3. Oceanology, Vol 9, No 3, p 355-360, 1969. 6 p, 3 fig, 9 ref.

Descriptors: *Brines, *Saline water, Sea water, Connate water, Salts, Salinity, Trace elements, Chlorides, Faults (Geology), Fractures (Geology), Water chemistry.
Identifiers: *Red Sea, Evaporite deposits.

The brines in the grabenlike bottom depressions of the Red Sea were formed by outflow of evaporite brines from Miocene salt-bearing deposits. This flow took place about 3500 years ago. In addition to high salinity (up to 310 g/liter), the brines have relatively high contents of potassium, iron, manganese, zinc, etc. Salt-bearing and gypsum-bearing Miocene rocks of thickness more than 2000-3000 m occur extensively in the Red Sea and adjoining land areas. (Knapp-USGS)
W70-04570

CHANGES IN CHEMICAL QUALITY OF GROUNDWATER IN THREE AREAS IN THE GREAT BASIN, UTAH,
Geological Survey, Salt Lake City, Utah.
A. H. Handy, R. W. Mower, and G. W. Sandberg.
Available for sale from Superintendent of Documents U S Government Printing Office, Washington, D C 20402-Price $3.75. Geological Survey Research 1969, Professional Paper 650-D, p D228-D234, 1969. 7 p, 8 fig, 1 tab, 7 ref.

Descriptors: *Water quality, *Groundwater, *Utah, *Saline water, Monitoring, Artesian wells, Water chemistry, Withdrawal, Water levels, Water level fluctuations, Irrigation water, Leaching, Infiltration, Evaporation, Hydrogeology.
Identifiers: Great Basin (Utah).

The chemical quality of groundwater in three areas in the Great Basin, Utah, is known to be deteriorating. West of Kanosh in Pavant Valley, an increase in all major constituents except bicarbonate has been associated with a decline in water levels that has resulted from a high rate of pumping. In the upper artesian aquifer near Leamington, in the Sevier Desert, an increase in dissolved solids, mainly sodium and chloride, has resulted from a change in the chemical quality of the water that is recharging the aquifer. Between Beryl and Enterprise in Escalante Valley, an increase in the concentration of all major constituents also has been associated with a decline in water levels caused by a high rate of pumping. (Knapp-USGS)
W70-04579

THE MIGRATION OF MANGANESE IN THE ARCTIC BASIN SEDIMENT,
Harvard Univ., Cambridge, Mass. Dept. of Geological Sciences; University of Southern California, Los Angeles. Dept. of Geological Sciences; and Lamont-Doherty Geological Observatory, Palisades, N. Y.
Yuan-Hui Li, James Bischoff, and Guy Mathieu.
Earth and Planetary Science Letters, Vol 7, No 3, p 265-270, December 1969. 6 p, 1 fig, 1 tab, 26 ref. ONR Contract Nonr 266 (82); NSF Grants Ga-4239 and Ga-1419.

Descriptors: *Water chemistry, *Sea water, *Bottom sediments, *Arctic Ocean, *Manganese sampling, Cores, Analytical techniques, X-ray analysis, X-ray spectroscopy.
Identifiers: Arctic Basin.

A relatively high content of manganese at the top of an arctic sediment core and a smooth exponential increment of manganese concentration in its interstitial water down to one meter have been found. The data strongly support the idea that manganese may be remobilized after burial by local reducing conditions. The thermodynamic calculation shows that the interstitial water is reaching chemical equilibrium with respect to manganese carbonate precipitate in the deeper part of the sediment. (Knapp-USGS)
W70-04591

CHEMICAL REACTION BETWEEN RECHARGE WATER AND AQUIFER WATER,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Cincinnati Water Research Lab.; and Cincinnati Univ., Ohio. Dept. of Mathematics.
D. L. Warner, and L. F. Doty.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 278-288, 1967. 11 p, 4 fig, 1 tab, 15 ref.

Descriptors: *Water chemistry, *Artificial recharge, Injection wells, Corrosion, Inhibition, Stabilization, Chemical precipitation, Water quality, Mixing, Chemical reactions, Physicochemical properties.
Identifiers: Injection well fouling, Water compatibility.

Chemical reaction between recharge water and aquifer water may influence water quality and aquifer permeability, and may cause fouling in discharge wells. However, evidence suggests that the danger of permeability reduction may not be very great. Precipitates of calcium and magnesium carbonate and iron compounds are the most likely reaction products. The amount and distribution of reactive chemicals remaining in solution can be related to the dispersive characteristics of a porous medium. Reactions of various rates are considered. It may be desirable to prevent reaction. It is suggested that, in some cases, this can be accomplished by emplacing a buffer zone of nonreactive water between the recharge water and the aquifer water. (Knapp-USGS)
W70-04615

THE NEBRASKA WATER QUALITY SURVEY,
Nebraska Univ., Lincoln. Coll. of Agriculture and Home Economics.
D. Knudsen, C. A. Hoover, P. Fischbach, and D. D. Axthelm.
Nebraska University Extension Service Report E. C. 65-165, November 1965. 26 p, 7 fig, 11 tab, 18 ref, append.

Descriptors: *Water quality, *Irrigation water, *Nebraska, *Groundwater, *Water pollution, Water chemistry, Water analysis, Data collections, Hydrologic data, Nitrates, Water pollution sources, Corrosion.
Identifiers: Groundwater pollution.

In general, the quality of Nebraska groundwater is good. There are, however, areas in the state where management practices should be followed to prevent excessive accumulation of salts. Potassium, calcium, magnesium and sulfur, all essential nutrient elements, are generally present in substantial quantities in Nebraska groundwater. Nearly two-thirds of the water samples tested contained enough boron to prevent boron deficiency in most crops. Thirty of the 1,166 samples tested furing the 1961 irrigation season had concentrations of 10 ppm or more nitrate-nitrogen. The 1,200 irrigation water samples of the year 1961 represent about 5% of the irrigation wells in the area of the state irrigated from groundwater. Laboratory determinations were made by the University of Nebraska Soil Testing Service for: Specific conductance, pH, Calcium, Sodium, Magnesium, Potassium, Nitrate, Phosphate, Carbonate, Bicarbonate, Chloride, Sulfate, Iron, and Boron. (Knapp-USGS)
W70-04616

SALT REJECTION BY SEA ICE DURING GROWTH,
Department of Energy, Mines and Resources, Dartmouth (Nova Scotia).
For primary bibliographic entry see Field 02C.
W70-04703

GEOCHEMISTRY OF SOME PETROLEUM-ASSOCIATED WATERS FROM LOUISIANA,
Bureau of Mines, Bartlesville, Okla. Petroleum Research Center.
A. Gene Collins.

Bureau of Mines Report of Investigations 7326, January 1970. 31 p, 9 fig, 12 tab, 51 ref.

Descriptors: *Geochemistry, *Brines, *Oil fields, *Louisiana, Dolomite, Diagenesis, Connate water, Water chemistry, Geologic formations, Oil reservoirs, Saline water, Groundwater.
Identifiers: Oil field brines.

Some of the geochemical relationships between subsurface fluids and the geologic strata in petroleum-producing areas of Louisiana were determined. Samples of petroleum-associated water were obtained from 126 wells in Louisiana from sediments of Tertiary, Cretaceous, and Jurassic ages. The dissolved constituents were compared with those of a brine that was concentrated by evaporation. The concentrations of bromide, calcium, and strontium were useful in distinguishing the brines produced from sediments of a late age from those of an earlier age. The concentration ratios of Mg and bromide indicated that dolomitization probably had occurred and altered the composition of the brines. A principal-components analysis of the data indicated an inverse relationship between depth and concentrations of bromide, strontium, calcium, and lithium. (Knapp-USGS)
W70-04710

ISOTOPIC ABUNDANCE OF OXYGEN AND SULFUR IN SULFATE IONS FROM RIVER WATER,
Laboratory of Nuclear Geology, Pisa (Italy).
A. Longinelli, and G. Cortecci.
Earth and Planetary Science Letters, Vol 7, No 4, p 376-380, January 1970. 5 p, 4 fig, 1 tab, 9 ref.

Descriptors: *Stable isotopes, *Oxygen, *Sulfur, *Water chemistry, Solutes, Biochemistry, Water analysis, Aquatic microorganisms.
Identifiers: Isotope fractionation, Oxygen isotopes, Sulfur isotopes, Italy.

The isotopic composition of dissolved sulfate has been studied in the Arno and Serchio Rivers in Tuscany (Italy). Large isotopic variations in both oxygen and sulfur take place along the course of these rivers in the direction of a progressive enrichment in the heavy isotopes. It is difficult to explain the results obtained, which are probably caused by several different factors. One of these factors is probably a widespread microbiological activity. (Knapp-USGS)
W70-04715

CHEMICAL QUALITY OF SURFACE WATER IN THE UMPQUA RIVER BASIN, OREGON,
Geological Survey, Portland, Oreg.
D. A. Curtiss.
Geological Survey Open-file report, 1969. 25 p, 4 fig, 6 tab, 8 ref.

Descriptors: *Water quality, *Surface waters, *Oxygen, Water chemistry, Solutes, Nutrients, Pesticides, Monitoring, Water pollution sources, Water supply, Data collections, Hydrologic data.
Identifiers: Umpqua River (Oregon), Douglas County (Oregon).

Samples were collected at 32 sites in the Umpqua River basin, Oregon; six of these sites were sampled and analyzed at 6-week intervals. The surface water is of generally excellent chemical quality throughout the basin. Analysis of water samples from two selected sites revealed detectable amounts of pesticides during the summer and fall of 1967. Herbicides were not detected during the study period. All surface water within the basin has a low sodium hazard and only traces of boron, and is therefore excellent for irrigation. A potential problem area exists on the South Umpqua River downstream from Roseburg. Because of heavy organic enrichment, insufficient discharge during low-flow periods and high temperatures during summer could cause water-quality problems. The water quality in this reach of the river should be monitored on a regular basis. (Knapp-USGS)
W70-04722

A ROUTINE METHOD FOR THE DETERMINATION OF TRITIUM BY ELECTROLYTIC CONCENTRATION BEFORE LIQUID SCINTILLATION COUNTING,
Ministry of Technology, London (England). Lab. of the Government Chemist.
P. Metson.
Analyst, Vol 94, No 1125, p 1122-1129, December 1969. 8 p, 4 fig, 2 tab, 17 ref.

Descriptors: *Tritium, *Water analysis, Analytical techniques, Radiochemical analysis, Radioisotopes, Electrolysis.
Identifiers: Tritium analysis.

A routine method is described for the measurement of tritium in rain and river waters by liquid scintillation counting after enrichment by electrolysis. A relatively large enrichment is achieved in a small cell by use of a continuous feed system that requires a minimum of attention. Electrolysis is carried out in a bank of standardized cells, and activities are obtained to an accuracy of better than 15% without the need for deuterium determinations. (Knapp-USGS)
W70-04735

IONIC CONCENTRATION GRADIENTS IN PERMAFROST, BARROW, ALASKA,
Army Terrestrial Sciences Center, Hanover, N.H.
Jerry Brown.
Cold Regions Research and Engineering Laboratory Research Report 272, October 1969. 25 p, 3 fig, 16 ref, 1 append. DA Task 1T061102B52A02.

Descriptors: *Permafrost, *Soil chemistry, *Water chemistry, *Solutes, Ions, Aqueous solutions, Leaching, Geomorphology, Freezing, Melting, Ion transport, Tundra, Soil water movement, Sea water.
Identifiers: Ionic concentration gradients.

The ionic concentration gradients of soils and permafrost sediments were investigated to provide a means of interpreting present and past chemical activity and geomorphological processes in the Arctic coastal plain environment. Within short distances at comparably shallow depths and in sediments of similar texture, ionic concentrations commonly vary between less than 1 meq/100 g and 10 meq/100 g. These differences represent modification of the marine sediment by such processes as lake migration and freshening, local and regional thawing, and leaching followed by refreezing of the ground. Higher concentrations (more than 5 meq/100 g) are found close to the surface in areas unaffected by such processes. Lower values (less than 5 meq/100 g) are encountered in present and ancient lake basins and under several apparent primary land surfaces. Two areas, one a drained lake basin and the other a well-developed polygon field, show depression of the ionic concentrations both vertically and laterally. A large drained basin situated close to sea level contains frozen sediments having very low ionic concentrations; this suggests the prior existence of a fresh-water lake. The seasonally thawed soil contains, on an average, 24 times fewer extractable ions than the underlying permafrost. Data for all samples are tabulated and include moisture content, conductivity of solution, and concentrations in solution and soils. (Knapp-USGS)
W70-04736

CHEMICAL ENVIRONMENT IN THE AQUATIC HABITAT,
Koninklijke Nederlandse Akademie van Wetenschappen, Amsterdam.
H. L. Golterman, and R. S. Clymo.
Proceedings of International Biological Program Symposium held in Amsterdam and Nieuwersluis, Netherlands, October 10-16, 1966. N V Noord-Hollandsche Uitgevers Maatschappij, Amsterdam, 1967. 322 p.

Descriptors: *Aquatic habitats, *Chemical analysis, *Aquatic environment, *Conferences, Environmental effects, Productivity, Physiological ecology, Organic matter, Bioassays, Nutrients, Phosphorus compounds, Nitrogen compounds, Nitrogen fixation, Oxidation reduction potential, Hydrogen ion concentration, Oxygen, Iron, Salinity, Vitamins, Sea water, Estuaries, Lakes, Plant pigments, Sediment-water interfaces, Molybdenum, Algae.
Identifiers: *Chemical environment, Hydrochemistry, International Biological Program, Netherlands, Netherlands Organization for Pure Scientific Research, Amsterdam (Holland), Nieuwersluis (Holland), Royal Netherlands Academy of Sciences, Hydrobiological Institute (Netherlands), Silicon compounds, Humic substances, Micronutrients, Microcompounds, Nutrient availability, Glucose, Acetate, Pheromones.

In October 1966, a symposium met at Royal Netherlands Academy of Sciences (Amsterdam) and Hydrobiological Institute (Nieuwersluis) to consider biologically-related problems of hydrochemistry. The conference, which this volume records, was sponsored by International Biological Program and Netherlands Organization for Pure Scientific Research. With an objective of preparing a manual of standardized methods, participants considered four types of problems: fate and determination of organic substances; availability of specific nutrient elements; physico chemical phenomena including nitrogen fixation, pH regulation, and interactions at sediment-water interfaces; and analytical techniques. Published proceedings are organized into 6 chapters as follows (numbers of contributions to each chapter indicated in parentheses): general papers (3); silicon, nitrogen, phosphorus compounds (5); technical papers (9); humic acids (2); micronutrients, microcompounds, and availability of compounds (6); miscellaneous topics (5). Topical coverage of some selected papers will indicate flavor, scope, and coverage of the symposium: 'integrative' and 'specific' properties of aquatic environments; quantitative relationships between nitrogen and phosphorus compounds in water and seston; automation in water analysis; composition and behavior of yellow acids in lacustrine water; determination of vitamins in seawater; pheromones and related substances; control of cations and pH in Sphagnum communities; mobility of sedimental compounds as related to sediment-water interchange. (See also W70-04882 and W70-04823). (Eichhorn-Wisconsin)
W70-04821

AUTOMATIC METHODS FOR THE ANALYSIS OF NATURAL WATERS,
Wisconsin Univ., Madison. Water Chemistry Lab.
For primary bibliographic entry see Field 07B.
W70-04822

DETERMINATION OF VITAMINS IN SEAWATER,
California Univ., San Diego, La Jolla. Inst. of Marine Resources.
For primary bibliographic entry see Field 07B.
W70-04823

CONCENTRATIONS OF MINOR ELEMENTS IN DIATOMACEOUS SEDIMENTS OF A STAGNANT FJORD,
Washington Univ., Seattle. Dept. of Oceanography.
For primary bibliographic entry see Field 02L.
W70-04996

SALINITY MEASUREMENTS IN ESTUARIES,
Swarthmore Coll., Pa. Dept. of Physics, and Woods Hole Oceanographic Institution, Mass.
For primary bibliographic entry see Field 02L.
W70-04999

CIRCULATION AND DIFFUSION,
Liverpool Univ. (England). Dept. of Oceanography.
For primary bibliographic entry see Field 02L.
W70-05004

DIAGENESIS OF IRON SULFIDE IN RECENT MARINE SEDIMENTS,
Yale Univ., New Haven, Conn. Dept. of Geology.
Robert A. Berner.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 268-272, 1967. 5 p, 4 fig, 18 ref.

Descriptors: *Diagenesis, *Sulfides, *Sediments, Pyrite, Iron, Sulfur, Hydrogen sulfide, Thermodynamics, Oxidation-reduction potential, Acidity, Water chemistry.
Identifiers: *Hydrotroilite, Limonite, Goethite, Marcasite.

Hydrotroilite, a fine-grained, black, iron sulfide is frequently found in recent sediments. X-ray and chemical study of hydrotroilite is difficult because of its low concentration, extreme susceptibility to air oxidation and fine-grained nature. Laboratory studies of iron components used metallic iron, dissolved ferrous iron and synthetic and natural goethite. The Eh of sediments containing hydrogen sulfide is discussed. The stability of iron minerals in anaerobic marine sediments is best expressed in terms of Eh-pS (-2) diagrams calculated from thermodynamic data. The mechanisms of transformation of FeS to pyrite are discussed. (Carstea-USGS)
W70-05008

SALT BALANCE AND CIRCULATION IN PARTIALLY MIXED ESTUARIES,
Washington Univ., Seattle. Dept. of Oceanography.
For primary bibliographic entry see Field 02L.
W70-05017

2L. Estuaries

THE EFFECT OF STRONG STORMS ON SAND BEACHES OF THE BALTIC EASTERN SHORE,
Akademiya Nauk SSSR. Institut Okeanologii.
Yu. D. Shuyskiy.
Transl from Okeanologiya, Akad Nauk SSSR, Vol 9, No 3. Oceanology, Vol 9, No 3, p 388-391, 1969. 4 p, 3 fig, 6 ref.

Descriptors: *Beach erosion, *Sediment transport, *Storms, Ocean waves, Geomorphology, Littoral drift, Surf, Damages, Erosion.
Identifiers: Baltic Sea.

The Baltic suffered a very violent recurring storm during October 17-20, 1967. It washed away the dunes over the entire stretch of the coast from the Samland Peninsula to the Gulf of Riga. The extent of erosion was 8000-24,000 cu m/km in 15-16 h. Different types of erosion are observed in different parts of the coast. However, the profile of the submarine slope remained relatively stable to a depth of 7-8 m. The position of the water's edge did not change, with the exception of sectors with steep submarine slopes. (Knapp-USGS)
W70-04566

THE MINERALOGICAL COMPOSITION OF SUSPENDED MATTER IN THE INDIAN OCEAN,
Akademiya Nauk SSSR. Institut Okeanologii.
V. V. Serova.
Transl from Okeanologiya, Akad Nauk SSSR, Moscow, Vol 9, No 3. Oceanology, Vol 9, No 3, p 378-388, 1969. 11 p, 5 fig, 1 tab, 17 ref.

Descriptors: *Sediments, *Indian Ocean, *Mineralogy, *Provenance, Chemical analysis, Suspended load, Sampling, Particle size, Silts, Antarctic.
Identifiers: Granulometric analysis.

Study of the mineralogical composition of centrifuged samples of suspended matter in the Indian Ocean revealed long-distance scattering of silt-sized particles. Terrigenous minerals are traced in the southern part of this ocean for a distance of more than 2000 km from their Antarctic sources. A similar picture is observed in the northern parts (Bay of Bengal, Arabian Sea). (Knapp-USGS)
W70-04568

COMPOSITION AND ORIGIN OF IRON-ORE SEDIMENTS AND HOT BRINES IN THE RED SEA,
Akademiya Nauk SSSR. Institut Okeanologii.
For primary bibliographic entry see Field 02K.
W70-04569

THE MIGRATION OF MANGANESE IN THE ARCTIC BASIN SEDIMENT,
Harvard Univ., Cambridge, Mass. Dept. of Geological Sciences; University of Southern California, Los Angeles. Dept. of Geological Sciences; and Lamont-Doherty Geological Observatory, Palisades, N. Y.
For primary bibliographic entry see Field 02K.
W70-04591

VOLUME TWO-TECHNICAL DEVELOPMENT PLAN, NATIONAL DATA PROGRAM FOR THE MARINE ENVIRONMENT.
System Development Corp., Santa Monica, Calif.
For primary bibliographic entry see Field 7C.
W70-04600

EFFECT OF PULSE RECHARGE ON THE ZONE OF DIFFUSION IN THE BISCAYNE AQUIFER,
Geological Survey, Miami, Fla. Water Resources Div.
For primary bibliographic entry see Field 02F.
W70-04606

A FRESH-WATER CANAL AS A BARRIER TO SALT-WATER INTRUSION,
Alberta Univ., Edmonton; and Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
For primary bibliographic entry see Field 04B.
W70-04610

DRAINAGE OF A SALINE-WATER AQUIFER RECHARGED BY FRESH WATER,
Windsor Univ. (Ontario). Dept. of Civil Engineering and Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 04B.
W70-04612

SALT WATER ENCROACHMENT IN THE COASTAL PLAIN OF ISRAEL,
Ministry of Agriculture, Jerusalem (Israel). Hydrological Service.
S. Schmorak.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 305-318, 1967. 14 p, 9 fig, 4 ref.

Descriptors: *Saline water intrusion, *Saline water-freshwater interfaces, Observation wells, Monitoring, Logging (Recording), Groundwater movement, Arid lands, Electrical well logging, Water levels, Recharge, Discharge (Water), Aquifers.
Identifiers: *Israel.

Field investigations have been carried out by the Hydrological Service since 1954 in three rows of specially constructed interface wells in the Plio-Pleistocene aquifer along the Mediterranean Coast of Israel. The purpose of the investigations was to find the exact location of the interface, to follow up its movement and to ascertain the velocity of the propagation inland in order to enable a rational exploitation of the aquifer. Methods of chemical logging have been developed and instruments built for measuring of electrical conductivity and temperature in situ and for recording of the interface movement. The tidal movement of the water level and the corresponding movement of the interface is being automatically recorded. The velocity of salt water encroachment was found to be approximately 20-70 m per year. The horizontal boundary of the salt water (toe of interface) has been found to be 0.2-1.6 km from the sea (except in the Tel-Aviv Region where distance is more than 2 km). (Knapp-USGS)
W70-04613

A STUDY OF SELECTED CHEMICAL AND BIOLOGICAL CONDITIONS OF THE LOWER TRINITY RIVER AND THE UPPER TRINITY BAY,
Texas A and M Univ., College Station. Water Resources Inst.
R. J. Baldauf, J. Von Conner, H. W. Holcombe, and F. M. Truesdale.
Available from the Clearinghouse as PB-190 269, $3.00 in paper copy, $0.65 in microfiche. Technical Report No 26, Texas Water Resources Institute, February 1970. 168 p, 27 tab, 22 fig, 101 ref. OWRR Project A-007-TEX.

Descriptors: *Estuaries, Ecology, Environmental effects, *Acquatic environment, Estaurine environment, Estaurine fisheries, *Crabs, *Shrimp.
Identifiers: Water development effects, Blue crab, White shrimp, Brown shrimp, *Menhaden (Gulf), Trinity Bay, Wallisville Reservoir (Proposed).

The study was done on the site of the proposed Wallisville Reservoir, one of several multipurpose structures designed for the water development of the Trinity River Basin in Texas. The Dam is to be located at Trinity River mile 3.9, where it will traverse about 22,000 acres of a low salinity marsh. The completion of the Wallisville Dam is expected to alter both the character of the marsh and of the Trinity Bay portion of the Galveston Bay System. The Dam will serve as an effective saltwater barrier in addition to serving as a river-water impoundment structure; about 12,500 acres of low salinity marsh will be inundated by the conservation pool. The study shows that the entire area serves as a nursery ground for white and brown shrimp, blue crab, and menhaden, and that this area will be lost to the dam site. The construction of the dam at least 4.5 miles farther upstream would have spared considerable nursery acreage from destruction.
W70-04687

TIDAL VARIATION OF THE SUSPENDED SEDIMENT SIZE DISTRIBUTION AT A STATION IN UPPER CHESAPEAKE BAY,
Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
J. R. Schubel.
Chesapeake Bay Institute Technical Report 63, Reference 70-2, Johns Hopkins University, February 1970. 28 p, 8 fig, 5 tab, 4 ref.

Descriptors: *Sediment load, *Sedimentation, *Suspended load, *Estuaries, Particle size, Velocity, Currents (Water), Tides, Deposition (Sediments), Erosion, Scour, Sediment transport, Bays, Sampling, Surveys, Data collections.
Identifiers: Chesapeake Bay.

Sediment size analyses were made of suspended sediment samples collected over a tidal cycle in Chesapeake Bay at three depths in 9.5 m of water. At the surface the volume-weighted mean Stokes' diameter ranged from 2.9 to 3.7 microns while the concentration of suspended sediment varied from 11.2 to 14.6 mg/liter. At 8 m the mean Stokes' diameter, the standard deviation, and the concentration of suspended sediment were progressively larger with increasing current speed and had their slack water background values with waning tidal currents. The mean Stokes' diameter ranged from 2.9 to 11.7 microns, the standard deviation from 5.2 to 14.5 microns, and the concentration of suspended sediment from 13.8 to 93.0 mg/liter. At 9 m the same pattern was observed, but the variations were greater. The mean Stokes' diameter ranged from 3.3 microns near slack water to 22.9 microns at maximum current. The standard deviation ranged from 5.0 to 24.5 microns and the concentration of suspended sediment from 19.5 to 201.1 mg/liter. (Knapp-USGS)
W70-04696

OCEANIC MIXING,
Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
Akira Okubo.
Chesapeake Bay Institute, Technical Report 62, Reference 70-1, Johns Hopkins University, January 1970. 119 p, 17 fig, 160 ref. Contract AT (30-1)-3109, USAEC Contract Nonr 4010 (11) ONR.

Descriptors: *Mixing, *Oceans, *Ocean currents, *Reviews, *Bibliographies, Diffusion, Turbulence, Advection, Convection, Environment, Path of pollutants, Mathematical models, Model studies.
Identifiers: Oceanic mixing.

The present knowledge of oceanic mixing is summarized. Two processes, 'advection' and 'diffusion,' which contribute substantially to oceanic mixing and their interaction are recognized in the mechanism of mixing. Environmental features of the sea in relation to advective and diffusive processes are also described. An annotated bibliography is included. (Knapp-USGS)
W70-04697

A DESCRIPTION OF THE SEASONAL THERMOCLINE CYCLE IN SHALLOW COASTAL WATER,
Naval Undersea Research and Development Center, San Diego, Calif.
J. L. Cairns, and K. W. Nelson.
Journal of Geophysical Research, Vol 75, No 6, p 1127-1131, February 20, 1970. 5 p, 5 fig, 8 ref.

Descriptors: *Water temperature, *Sea water, *Thermocline, *Thermal stratification, *Coasts, California, Pacific Ocean, Ocean currents.
Identifiers: San Diego (Calif).

Details of the annual thermocline cycle in the coastal area off San Diego have been determined from temperature data recorded hourly for over a year at the Naval Undersea Research and Development Center Oceanographic Tower. Vertical thermal gradients averaged 0.59 deg C/m at their strongest part from late April through early September. The sharpest gradients, which occurred in late June, were as great as 1.27 deg C/m. Transient gradients averaging 0.29 deg C/m at their strongest part occurred frequently in late March and early April and from late September through early November. Weak thermal gradients averaging 0.15 deg C/m at their sharpest predominated from late November through early March. Water temperature varied from 9.7 deg to 23.6 deg C. Internal tides persisted throughout the year, contributing to monthly temperature variances that ranged from 0.2 in January to 5.6 in May and August. (Knapp-USGS)
W70-04706

A NOTE ON THE THERMAL STRUCTURE OF THE EASTERN BERING SEA,
Hokkaido Regional Fisheries (Japan). Research Lab.
Kiyomitsu Kitano.
Journal of Geophysical Research, Vol 75, No 6, p 1110-1115, February 20, 1970. 6 p, 5 fig, 13 ref.

Descriptors: *Thermal stratification, *Ocean circulation, *Ocean currents, Oceanography, Water temperature, Mixing.
Identifiers: *Bering Sea, Aleutian Islands.

A detailed thermal structure in the eastern Bering Sea is described, based on data obtained during the summers of 1964-66. Extremely cold water moves over the continental shelf in the eastern Bering Sea and warm water intrudes mainly across the Amukta and Amchitka passes. Some of the tendency of decrease and increase of temperature is also shown by a vertical section. The typical feature of vertical temperature distribution is the presence of five stratified thermal layers. (Knapp-USGS)
W70-04708

AN OPTICAL AND HYDROGRAPHIC STUDY OF A TEMPERATURE INVERSION OFF OREGON DURING UPWELLING,
Oregon State Univ., Corvallis. Dept. of Oceanography.
Hasong Pak, George F. Beardsley, Jr., and Robert L. Smith.
Journal of Geophysical Research, Vol 75, No 3, p 629-636, January 20, 1970. 8 p, 8 fig, 12 ref. ONR Contract Nonr 1286 (10).

Descriptors: *Ocean circulation, *Water temperature, *Productivity, Oregon, Oceanography, Ocean currents, Thermal stratification, Hydrography, Sounding, Surveys.
Identifiers: Ocean upwelling.

Optical and hydrographic measurements made in June 1967 during upwelling along the Oregon coast showed a temperature inversion starting 3 km from the shore and extending to 13 km from the shore. The thermal inversion was accompanied by a turbidity maximum in the permanent pycnocline. The mechanism for the formation of the temperature inversion and turbidity maximum appears to be cold, saline water upwelling from beneath the permanent pycnocline to the surface close to the coast, absorbing heat, and becoming biologically productive. This modified upwelled water then appears to move gradually offshore, sinking along the permanent pycnocline which slopes up to near the surface during upwelling. The modified upwelled water is warmer (but more saline), contains more scatterers than water of similar densities offshore, and thus appears as a thermal and optical inversion. The turbidity maximum was observed to persist after the temperature inversion disappeared, which would indicate that the circulation pattern remains even when insufficient heat is absorbed by the upwelled water to generate a thermal inversion. (Knapp-USGS)
W70-04709

A PRELIMINARY REPORT ON THE CHARACTERISTICS OF A HEATED JET DISCHARGED HORIZONTALLY INTO A TRANSVERSE CURRENT, PART 1 - CONSTANT DEPTH,
Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
For primary bibliographic entry see Field 05B.
W70-04716

PHYTOPLANKTON NUTRIENTS IN ESTUARIES,
Woods Hole Oceanographic Institution, Mass.
Bostwick H. Ketchum.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 329-335, 1967. 7 p, 10 fig, 1 tab, 12 ref. Contracts AT (30-1)-1918 (AEC), and No 2196 (ONR).

Descriptors: *Nutrients, *Estuaries, *Eutrophication, Phosphorus, Water pollution, Salinity, Rivers, Phytoplankton, Sea water, Brackish water, Mixing.
Identifiers: Juan de Fuca Strait, New York Bight.

Estuaries can be enriched in nutrients by river waters, pollution, or sea water. Local enrichment of estuaries by rivers may be important, but it appears that this source cannot usually be invoked to explain productivity. The Strait of Juan de Fuca is cited as an example of nutrient enrichment due to sea water drawn from depths below the euphotic zone. In this zone, the concentration of nutrients has not been depleted by the growth of phytoplankton. Total phosphorus and salinity were used to identify 3 different sources of water in the New York Bight. The 3 types of water are: (1) Brackish river water with 30 ppt salinity; (2) surface coastal water with 30.95 ppt and (3) deep ocean water with 34 ppt salinity. In addition to the type of water, the population of phytoplankton will depend on factors such as grazing, the stability of the water column, the presence of vitamins or inhibitors in the water, and water transparency. (Carstea-USGS)
W70-04993

LAYERED SEDIMENTS OF TIDAL FLATS, BEACHES, AND SHELF BOTTOMS OF THE NORTH SEA,
Research Inst. for Geology and Biology. Wilhelmshaven (West Germany).
For primary bibliographic entry see Field 02J.
W70-04994

ESTUARINE RESEARCH IN THE DANISH MORAINE ARCHIPELAGO,
Copenhagen Univ. (Denmark). Geographical Lab.
Axel Schow.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 129-145, 1967. 17 p, 23 fig, 33 ref.

Descriptors: *Estuaries, *Research and development, Tidal effects, Glaciation, Channels, Sediments, Sedimentation rates, Salt marshes, Land reclamation.
Identifiers: *Denmark, *Jutland Peninsula, Danish Moraine Archipelogo.

Tidal environment in Denmark is discussed,including the glacio-geomorphological characteristics, marine activity, tidal flats and tidal channels of the Danish Archipelago. Results of research programs in erosional forms (tidal creeks and tidal channels), rate of sedimentation, and accumulation forms (tidal flats and salt marshes) are discussed. Estuarine research is used as a basis for land reclamation and study of the paleogeography of the Danish estuary region. Denmark is an archipelago in the strictest sense and its land is strongly dissected by water. Typical estuarine conditions occur only on the southwest shoreline of the Jutland Peninsula. (Carstea-USGS)
W70-04995

CONCENTRATIONS OF MINOR ELEMENTS IN DIATOMACEOUS SEDIMENTS OF A STAGNANT FJORD,
Washington Univ., Seattle. Dept. of Oceanography.
M. Grant Gross.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 273-282, 1967. 10 p, 10 fig, 3 tab, 36 ref.

Descriptors: *Trace elements, *Sediments, *Sedimentation, *Fjords, Inlets (Waterways), Diatoms, Sulfides, Sea water, Sediment-water interfaces, Elements (Chemical).
Identifiers: *Canada, *Saanich Inlet, *British Columbia, Stagnant Fjords.

The concentration of a minor element in sediments of Saanich Inlets, British Columbia, depends on the concentration of the elements in the lithogenous and biogenous sources of bottom sediments and in the sulfide-bearing water. Sc, Y, Ti, Zr, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ga, and Pb were associated primarily with the lithogenous constituents. The concentration of Mo increases in deposited sediments and is probably coprecipitated with iron sulfides from sea water near the water-sediment interface. The concentrations of other minor elements in the sediments did not change greatly. (Carstea-USGS)
W70-04996

SOME ASPECTS OF THE DYNAMICS OF CIRCULATION IN FJORDS,
Washington Univ., Seattle. Dept. of Oceanography.
Maurice Rattray, Jr.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 52-62, 1967. 11 p, 21 fig, 11 ref.

Descriptors: *Water circulation, *Fjords, Salt balance, Pressure, Bathymetry, Estuaries, Equations, Diffusion, Advection.
Identifiers: *Strait of Georgia, *Strait of Juan de Fuca, San Juan Channels.

Dynamic balance and salt balance were used to describe water circulation in fjords. In most cases, the balance of forces is given by the equality of the

horizontal pressure gradient and the vertical gradient of turbulent stress. The exceptions occur when the horizontal acceleration terms become important in the upper circulation, or because of bathymetric effects. Upper circulation is the unique feature of fjords which separates them dynamically from other estuarine systems. The salt-balance equation represents a balance between horizontal advection and diffusion over the sills; a balance between vertical diffusion, and possible time changes in the deep circulation; and between advection and vertical diffusion in the near-surface circulation. Examples are given to illustrate the dynamic balance which exists for a wide range of fjord conditions. An approximate similarity solution, given for the circulation in the upper layers of a fjord, provides a good representation of all the important features of this circulation. (Carstea-USGS)
W70-04997

THE ONTOGENY OF A SALT MARSH ESTUARY,
Woods Hole Oceanographic Institution, Mass.
Alfred C. Redfield.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 108-114, 1967. 7 p, 6 fig, 1 tab, 13 ref. NSF Contract GP 2042.

Descriptors: *Estuaries, *Salt marshes, *Sedimentation, Sediments, Radioactive dating, Carbon radioisotopes, Dating, High water mark, Sea level, Sedimentary structures, Channels, Meanders.
Identifiers: *Salt marsh estuary, Sand spits.

The history of the development of a typical New England salt marsh (Sandy Neck, Mass), and of the estuary which it now occupies is reconstructed. The depth of peat decreases progressively eastward along the south side of Sandy Neck. Relief similar to that of the adjacent upland is suggested by the contours along the upland margin of the marsh, whereas the relief is relatively low in the central part. A series of cores was collected across the marsh from the upland to one of the major creeks to examine the relation of high marsh peat, intertidal peat, and composition of the substratum. Carbon-14 dating was used to establish the time at which mean high water reached any given elevation as sea level rose. The sand spit has grown eastward during a period of about 4,000 years. The development of marsh along the margin of the sand spit proceeded more slowly because the basin deepened with distance from the upland and more time was required for sedimentation to reduce its depth. High marsh has now extended to the margin of meandering channels and the creeks now are in quasi-equilibrium with the hydraulic forces. (Carstea-USGS)
W70-04998

SALINITY MEASUREMENTS IN ESTUARIES,
Swarthmore Coll., Pa. Dept. of Physics, and Woods Hole Oceanographic Institution, Mass.
Paul C. Mangelsdorf, Jr.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 71-79, 1967. 9 p, 6 fig, 24 ref.

Descriptors: *Salinity, *Estuaries, Mixing, Tracers, Ecology, Instrumentation, Electrical conductance, Analytical techniques, Specific gravity, Electrodes, Membranes, Ion exchange.
Identifiers: Estuarine salinity determinations.

Salinity measurements in estuaries can be used for: (1) Studies of transport, flushing and mixing; (2) a tracer to label different water masses; (3) ecological factors, and (4) water uses for the streams flowing into an estuary. Salinity can be measured by determination of the electrical conductivity of water. Conductivity meters, chlorinity titrations, specific gravity methods, refractive index, selective electrodes, sodium electrode, and ion-exchange membrane electrodes are used to determine salinity. (Carstea-USGS)
W70-04999

EPHEMERAL ESTUARIES OF THE DELTAIC ENVIRONMENT,
Louisiana State Univ., Baton Rouge. Coastal Studies Inst.
James P. Morgan.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 115-120, 1967. 6 p, 8 fig, 19 ref.

Descriptors: *Estuaries, *Deltas, *Quaternary period, Rivers, Land subsidence, Channels, Sea level, Sedimentation, Ocean waves, Tidal energy, Tidal waters, Coasts.
Identifiers: Mississippi Delta, Ganges-Brahmaputra, Deltaic estuaries, Interdeltaic estuaries, Estuarine tidal channels.

The Quaternary history of river mouths is discussed. The physiography of a deltaic area is the product of fluvial deposition and coastal erosion as influenced by the predeltaic topography. Three distinct deltaic estuarine types are, deltaic estuaries, interdeltaic estuaries, and estuarine tidal channels. Illustrations were selected from the Mississippi Delta (a low-tide and low-energy environment) and the high-tide regime of the Ganges-Brahmaputra system. Deltaic estuaries are a product of the delicate balance between variations in sea level, coastal progradation through sedimentation, and coastal retreat under wave attack. Estuarine morphology of the deltaic environment is subject to rapid modification and, from the standpoint of geologic time, deltaic estuaries are ephemeral in nature. (Carstea-USGS)
W70-05000

REGIONAL GEOMORPHOLOGICAL CHARACTERISTICS OF SOME AUSTRALIAN ESTUARIES,
Australian National Univ. (Canberra).
J. N. Jennings, and E. C. F. Bird.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 121-128, 1967. 8 p, 10 fig, 33 ref.

Descriptors: Estuaries, *Geomorphology, *Sedimentation, River flow, Tides, Sediments, Mineralogy, Sands, Beach erosion, Dunes, Sedimentary structures, Runoff, Bays, Barriers.
Identifiers: Australia, Estuarine geomorphology.

The estuarine geomorphology of Australia is discussed in terms of: (1) river flow; (2) wave energy; (3) tides; (4) sedimentation processes; (5) mineralogy of beach sands and lithology of dunes; and (6) neotectonic effects. Due to aridity, the Australian rivers generally have low runoff coefficients and only few have perennial flow. Extensive barriers have been built up at the river mouths along the coast of Australia from Shark Bay in Western Australia southward to Cape Leeuwin, eastward to Cape Howe, and northward to Fraser Island in Queensland. This coast is characterized by a high wave energy. The tropical coasts are subject to less persistently energetic wave regimes. The high wave energy coasts have low to moderate tidal ranges whereas the tropical coasts are subject to tides of moderate or high ranges. Sedimentation is influenced by biotic factors of salt marshes, mangrove swamps, and reed swamps. (Carstea-USGS)
W70-05001

SEDIMENTS OF YAQUINA BAY, OREGON,
Oregon State Univ., Corvallis. Dept. of Oceanography.
For primary bibliographic entry see Field 02J.
W70-05002

SOME FEATURES OF THE HYDROGRAPHY OF NORWEGIAN FJORDS,
Bergen Univ. (Norway). Inst. of Geography.
Odd H. Saelen.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 63-70, 1967. 8 p, 14 fig, 3 ref.

Descriptors: *Fjords, *Hydrography, Glaciation, Salinity, Stratification, Density, Water circulation, Currents (Water), Fresh water, Brackish water
Identifiers: *Norwegian fjords, Sognefjord, Hardangerfjord.

The length of Norwegian fjords varies from a few kilometers up to the 176 km of Sognefjord. Aside from being the largest, this fjord is also the deepest with a maximum depth of nearly 1,300 m. Most of the Norwegian fjords do not exceed 600 m. Most fjords have 2 water layers. The upper layer has low salinity and density; the lower layer has high salinity and density. This stratification varies seasonally and it is most pronounced during summer. The two main features of fjord circulation are currents connected with fresh water supply and movements in the deeper layer. (Carstea-USGS)
W70-05003

CIRCULATION AND DIFFUSION,
Liverpool Univ. (England). Dept. of Oceanography.
K. F. Bowden.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 15-36, 1967. 22 p, 10 fig, 3 tab, 68 ref.

Descriptors: *Water circulation, *Diffusion, *Estuaries, Saline water intrusion, Mixing, River flow, Flow, Coriolis force, Model studies, Diffusivity, Salinity, Fjords.
Identifiers: *Estuarine circulation.

Estuarine circulation types include salt wedge, two-layer flow with entrainment, two-layer flow with vertical mixing, vertically homogeneous (with lateral variation and laterally homogeneous), and intensive mixing. Interaction between the river flow and tidal currents is influenced by the physical dimensions of the estuary and by the Coriolis force. The basic principles of circulation and mixing are briefly summarized. Flushing time, two-layer models, tidal prism and segmentation methods, mixing length theory, effective horizontal diffusivity, and other methods have been devised for computing the rate at which river water is flushed out of an estuary. Diffusion problems and wind effects on estuarine circulation are discussed. Water movements, mixing processes, and the distribution of salinity which results from their combined action are the main physical problems to be investigated in an estuary. (Carstea-USGS)
W70-05004

THE SEDIMENTS OF CHESAPEAKE BAY,
Maryland Univ., Solomons. Natural Resources Inst.
For primary bibliographic entry see Field 02J.
W70-05005

NOTES ON ESTUARINE POLLUTION WITH EMPHASIS ON THE LOUISANA GULF COAST,
Public Health Service, Cincinatti, Ohio. Div. of Water Supply and Pollution Control.
For primary bibliographic entry see Field 05B.
W70-05006

CONTRASTS IN COASTAL BAY SEDIMENTS ON THE GULF AND PACIFIC OCASTS,
University of Southern California, Los Angeles. Dept. of Geological Sciences.
For primary bibliographic entry see Field 02J.
W70-05007

DIAGENESIS OF IRON SULFIDE IN RECENT MARINE SEDIMENTS,
Yale Univ., New Haven, Conn. Dept. of Geology.
For primary bibliographic entry see Field 02K.
W70-05008

SEDIMENTARY PATTERNS OF MICROFAUNA IN A COASTAL PLAIN ESTUARY,
Virginia Inst. of Marine Science, Gloucester Point; and Virginia Univ., Charlottesville. Dept. of Geology.
M. M. Nichols, and R. L. Ellison.
NSF Grant G20443. In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 283-288, 1967. 6 p, 6 fig, 2 tab, 10 ref.

Descriptors: *Estuaries, *Sediments, *Sedimentation, *Aquatic microorganisms, Microorganisms, Coastal plains, Marshes, Aquatic life, Rivers, Fresh water, Shoals, Sedimentation rates, Brackish water.
Identifiers: *Rappahannock Estuary, Foraminifera, Ostracoda.

Core samples were taken of surface sediments from 148 stations in waters and marshes of the Rappahannock Estuary in northeastern Virginia. The sedimentary Foraminifera, Ostracoda, and Thecamoebina were studied. Different types of estuarine waters appear to determine the patterns of microfauna. The river subfacies containing Thecamoebina are found in the freshened part of the estuary; arenaceous Foraminifera are found in the shoal subfacies; the lower, deeper water of the estuary is inhabited by the basin subfacies of calcareous Foraminifera. Standing crops of Foraminifera may change in size and position from year to year. The ratios of living specimens of Foraminifera to total tests showed little relationship to the sedimentation rates. Comparison with other areas is discussed. (Carstea-USGS)
W70-05009

COMPARISON OF RECENT AND ANCIENT TIDAL FLAT AND ESTUARINE SEDIMENTS,
Pennsylvania Univ., Philadelphia. Dept. of Geology.
For primary bibliographic entry see Field 02J.
W70-05010

QUANTITATIVE RESEARCH ON LITTORAL DRIFT AND TIDAL INLETS,
Florida Univ., Gainesville. Coastal Engineering Lab.
J. A. Battjes.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, - 185-190, 1967. 6 p, 3 fig, 1 tab, 5 ref.

Descriptors: *Littoral drift, *Sediment transport, Research and development, Inlets (Waterways), Sands, Tracers, Tracking techniques, Aerial photography, Ocean waves, Currents (Water).
Identifiers: Coastal sedimentation.

Longshore sand drift, sand transport through inlets and stability of inlets are discussed quantitatively. Littoral drift is measured in the field and laboratory by fluorescent tracer and aerial photography methods. Aerial photography of several wave lengths of the migrating sand waves gives simultaneous quantitative data over an extended area and shows patterns and details. The laboratory equipments are carried out in tanks and the effects of both waves and currents on sediment transport are studied. The three kinds of inlet stability are bypassing stability, location stability and cross-sectional stability. (Carstea-USGS)
W70-05011

RATES OF SEDIMENT ACCUMULATION IN MODERN ESTUARIES,
Miami Univ., Fla. Inst. of Marine Science.
Gene A. Rusnak.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 180-184, 1967. 5 p, 5 fig, 20 ref.

Descriptors: *Sedimentation rates, *Sediments, *Estuaries, Deposition (Sediments), Environment, Continental shelf, Continental slope, Deep water, Rivers, Provenance, Lagoons, Bays, Climates, Arid climates, Humid climates.
Identifiers: Estuarine sedimentation.

The four broad environmental categories of marine sedimentation are: (1) The marginal marine environment containing estuaries; (2) the continental shelf; (3) the continental slope; and (4) the deep sea. Positive-filled estuaries are those that are filled entirely by river-transported sediment inflow. Inverse-filled estuaries are those that are filled solely or to the largest extent by sediments entering the estuary from the sea. Redistribution of basin sediment from local shoreline margins within the basin can be considered as neutral-filled (non-filling) basins. The rate of sediment accumulation in a basin is dependent upon source of supply, geographic position, and climate. The best estimates for accumulation rates are 2 m per thousand years for humid bays and estuaries, and 1 m per thousand years for arid and semi-arid lagoons. (Carstea-USGS)
W70-05012

ORIGIN OF SEDIMENTS IN ESTUARIES,
Paris Univ. (France). Institut de Geographie.
Andre Guilcher.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 149-157, 1967. 9 p, 12 fig, 37 ref.

Descriptors: *Sediments, *Provenance, *Estuaries, Sediment discharge, Suspended load, Deltas, Rivers, Slopes, Deposition (Sediments), Sediment transport, River beds, Tidal waters.
Identifiers: Estuarine sedimentation.

A possible source of estuarine sedimentation differences may be the quantitative contrasts in discharge of solid materials by rivers. Fine material eroded from the slopes of estuaries can take the place of sediments coming from upstream when river discharge is insignificant. Water motion within the estuary must also be taken into account. The penetration of marine sediments into estuaries can be due to the wedge of salt water flowing upstream along the bottom. In some estuaries, a motionless lens of water persists near the bottom during a large part of the tidal period. The position and duration of this motionless water body varies with the river discharge and tidal range. The lens acts as a weir in which the coarse particles flowing along the bottom are trapped, whereas the finer elements flowing in suspension in the upper water layer pass over it. If the lens is located near the mouth of the river, a delta can be built; but if it is located far upstream, the fluvial sediments settle before they reach the middle and lower parts of the estuary. (Carstea-USGS)
W70-05013

WHAT IS AN ESTUARY: PHYSICAL VIEW POINT,
Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
Donald W. Pritchard.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 3-5, 1967. 3 p.

Descriptors: *Estuaries, *Classification, *Tidal waters, Salinity, Mixing, Water circulation, Bays, Fjords, Rivers, Valleys, Water chemistry, Barriers, Sedimentary structures, Density.
Identifiers: Definition of estuaries, Classification of estuaries.

A definition of an estuary should recognize certain basic similarities in the distribution of salinity and density. The circulation pattern, mixing processes and the importance of boundaries which control the distribution of physicochemical properties in an estuary should also be considered. A definition is given which takes into account these considerations. This definition is widely recognized. Based on geomorphological considerations, estuaries are classified into 4 primary groups: (1) drowned river valley; (2) fjord-type estuaries; (3) bar-built estuaries; and (4) estuaries produced by tectonic processes. Each one of these categories is briefly discussed and examples are provided. (Carstea-USGS)
W70-05014

ESTUARIES: ANALYSIS OF DEFINITIONS AND BIOLOGICAL CONSIDERATIONS,
Hamburg Univ. (West Germany). Museum of Zoology.
Hubert Caspers.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p6-8, 1967. 3 p, 18 ref.

Descriptors: *Estuaries, *Lagoons, *Biological properties, *Water chemistry, Tidal waters, Fresh water, Inflow, Sea water, Biota, Boundaries (Surfaces), Mixing.
Identifiers: Poikilohalinity.

The definitions of estuaries given by Emery and Stevenson, Ketchum, and Pritchard are critically analyzed. Instability of salinity is suggested as a distinguishing factor between lagoons and estuaries. A stable body of brackish water may be considered a lagoon whereas an estuary is characterized by an unstable mixing of fresh and marine waters. The unstable conditions of estuaries determines their principal biological features. The main characteristics of estuaries are: (1) They are limited to river mouths in tidal seas; (2) the extent of saline areas in estuaries depends on the amount of fresh water inflow; (3) estuaries are characterized by instability of environmental factors and poikilohalinity. Examples of flora and fauna of an estuary are presented. (Carstea-USGS)
W70-05015

ESTUARIES AND LAGOONS IN RELATION TO CONTINENTAL SHELVES,
Woods Hole Oceanographic Institution, Mass.
K. O. Emery.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 9-11, 1967. 3 p, 1 fig.

Descriptors: *Estuaries, *Lagoons, *Continental shelf, Sediments, Sea level, Sedimentary structures, Sands, Deposition (Sediments), Sediment transport, Radioactive dating, Sedimentation rates, Pleistocene epoch.
Identifiers: Sand ridges, Sea level rise.

This paper discusses the regional aspects of estuaries and lagoons, describes the continental shelves, and examines the sea level variations during the pleistocene epoch. Postglacial rise of sea level developed estuaries near the shelf-break, lagoons on the outer half, lagoons and estuaries near the middle, and estuaries on the nearshore part of many continental shelves. Continued rise of sea level allowed the sands to cover the shelf to the highest level of the sea. After reaching this stage, the sands will prograde back across the shelf as a succession of seaward-growing sand ridges, and perhaps offshore bars and barrier islands of lagoons. Radiocarbon dating of shallow-water shells indicates a rise of sea level from about minus 100 m 18,000 years ago to minus 20 m 9000 years ago. The rate decreased steadly from 9 m to 3 m per thousand years. (Carstea-USGS)
W70-05016

SALT BALANCE AND CIRCULATION IN PARTIALLY MIXED ESTUARIES,
Washington Univ., Seattle. Dept. of Oceanography.
Donald V. Hansen.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 45-51, 1967. 7 p, 11 fig, 14 ref. Grants G19788 and GP1101. NSF Contracts Nonr 477 (10) and Nonr 477 (37). Project NR 083 012.

Descriptors: *Salt balance, *Estuaries, *Mixing, *Water circulation, Salinity, Theoretical analysis, Tidal waters, Wind tides, Wind pressure, River flow, Discharge (Water).

Identifiers: Rayleigh number, Tidal mixing, Partially mixed estuaries.

The kinematics of the mean salinity distribution and the circulation in partially mixed estuaries are discussed. Similarity and non-similarity solutions with exponential and constant salinity gradients are given. The theoretical results are in agreement with observations of river discharge, tidal mixing, width, and depth. Velocity profiles in estuaries cannot be inferred precisely from the salinity distribution alone. The nature of the velocity profile depends upon an estuarine counterpart of the Rayleigh number and this number can be determined if mean wind stress, the mean velocity at a single depth, and the river discharge are known. (Carstea-USGS)
W70-05017

SEDIMENT TRANSPORT AND SEDIMENTATION IN THE ESTUARINE ENVIRONMENT,
Netherlands Inst. for Sea Research, Den Helder.
H. Postma.
In: Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 158-179, 1967. 22 p, 24 fig, 3 tab, 59 ref.

Descriptors: *Sediment transport, *Sedimentation, *Estuaries, Environment, Tidal waters, Erosion, Scour, Deposition (Sediments), Suspended load, Turbidity, Water circulation.
Identifiers: *Estuarine sedimentation, Scour lag effects, Settling lag effects.

Sediment movement and sedimentation in nearshore waters, tidal flats, and estuaries are reviewed. The main topics discussed are: (1) Erosion, transportation and deposition; (2) flocculation and deflocculation; (3) transport of suspended matter by tidal currents; (4) transport of suspended matter in estuarine circulation systems; and (5) bottom sediments. Some of the accumulation mechanisms which retain suspended matter near the coast are settling and scour lag effects. Density differences which occur in and near rivers may result in the concentration of suspended materials in turbidity maxima. Flocculation promotes the retention and sedimentation of fine-grained sediments. (Carstea-USGS)
W70-05018

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

COMPARISON OF CHEMICALLY AND ELECTROLYTICALLY INDUCED PITTING CORROSION,
General Motors Corp., Warren, Mich. Dept. of Chemistry; and Connecticut Univ., Storrs. Corrosion Research Lab.
For primary bibliographic entry see Field 08G.
W70-04550

FRESH WATER SUPPLIES THROUGH DESALINATION,
Department of the Interior, Washington, D.C.
Chung-Ming Wong.
Water Wastes Eng, Vol 6, No 11, p F-7-F-9, Nov 1969. 3 p, 3 photo.

Descriptors: *Deslaination, *Demineralization, Fresh water, Sea water, Water costs, Brackish water, Potable water, Brines, Technology, Electric power production, Nuclear powerplants, Water supply, Multiple purpose, Distillation, Corrosion, Membrane processes, Economics.
Identifiers: Cost savings, Multistage flash distill, Corrosion resistant alloys.

With the seas offering an unlimited source of water, many convincing arguments are presented for desalination. Desalting provides an entirely new source of high-quality water for needs as they arise. Potable water can be manufactured at locations and in time frames of man's own choosing without depending on the whims of nature. Desalting plants can be located in or near areas of greatest need to produce fresh water and, in some cases, electricity in a joint nuclear-powered operation. Other types of plants, using water of far less salinity than sea water, can provide modest additions to the water supply for small- and medium-sized urban areas at a pace easily adjusted to growth. Technical advances, materials development, and cost reduction that have occurred in desalination processes since 1952 are discussed. (USBR)
W70-04647

EVAPORATIVE FREEZING PROCESS FOR WATER DESALINATION,
Catholic Univ. of America, Washington, D.C.
H. M. Curran, and C. P. Howard.
Office of Saline Water Research and Development Progress Report No. 511, 1969. 95 p, OSW Contract 14-01-0001-1266.

Descriptors: *Freezing, Desalination Processes, Evaporation, Melting, *Salinity.
Identifiers: *Evaporative Freezing, Washing, *Batch desalination process.

A batch-type evaporative freezing process was evaluated at the bench-scale level. Saline water is sprayed into a rotating cylindrical basket at a pressure below the triple-point pressure. Removal of vapor results in formation of a semi-solid layer of ice on the later surface of the basket. The entrained brine is removed by washing and the residual ice is melted. The optimum design requires that freezing, washing and melting steps be of equal duration, and the optimum plant consists of three modules, in each of which freezing, washing and melting steps be of equal duration, and the optimum plant consists of three modules, in each of which freezing, washing, and melting operations occur in succession and out-of-phase with the other two. The heat removed by evaporative freezing in one module is used to melt the washed ice in another module. The minimum energy consumption is estimated to be 50 to 60 KWH per 1000 gallons of product at a 50 per cent conversion. Because of the amount of energy required and the complexity of the equipment the economic feasibility of the process is questionable. (Rinne-Office of Saline Water)
W70-04649

SURVEY OF CONDENSER TUBE LIFE IN SALT WATER SERVICE,
Little (Arthur D.), Inc., Cambridge, Mass.
E. H. Newton, and J. D. Birkett.
OSW R and D Progr. Rept. No. 278, Aug. 1967. 71 p, 11 fig, 11 tables.
Identifiers: *Condensers, *Copper alloys, *Tubing (Metal), Cathodic projection, Equipment failures, Iron alloys, Maintenance, Operating experience, OSW sponsored, PH adjustment, Protective coatings, Scale removal, Stainless steels, Water flow.

Results are presented of survey of 56 coastal power plants using various heat-exchanger tube materials and seawater for cooling. Data were obtained on 237 tube sets of 8 different alloys. Total of 1,778,000 tubes was involved. A table summarizes results for 6 more commonly used materials based upon percent probability of tubes lasting x years with no more than y percent tubes failed.
W70-04656

SOME PRACTICAL ASPECTS OF DESALINATION BY EVAPORATION,
J. M. Stewart.
Proc. 1st Intern. Symp. Water Desalination, Wash, 1965, p 651-74, 1967. 6 fig, 9 ref.
Identifiers: *Corrosion control, *Distillation processes, *Evaporators, Brine flow, Feedwater treatment, Heat transfer coefficient, Pumps, Scale prevention, Tubing (Metal).

Distillation plants may be classified in 6 groups (1) domestic supply, (2) boiler feed and chemical processes, (3) private supply, (4) emergency supply, (5) marine use, (6) agricultural. Each group has its own set of criteria with regard to size, cost, and dependability. However, some general limitations as to size or capacity can be set out. (1) Heat transfer coefficients are effectively in the range of 450 to 550 btu/hr sq ft deg F. (2) There is a maximum useful size for the brine recirculating pump. (3) To keep the plant within practical physical limits, the brine circulation is limited to about 1 million lb/hr ft of width of evaporator shell. (4) Tubes are probably limited to 80 ft of 1-in. od tubing. (5) Brine temperature is limited to 250 deg F with acid feedwater treatment. There is much development work to be done before plants in excess of 10 mgd can be a commercial proposition.
W70-04657

ANALYSIS OF DIFFERENT DESIGNS OF DISTILLATION DESALINATION,
S. I. Golub, V. B. Chernozubov, E. A. Sobolev, and M. B. Weisblatt.
Proc. 1st Intern. Symp. Water Desalination, Wash, 1965, p 515-25, 1967. 3 fig, 3 tab, Paper SWD/79
Identifiers: *Distillation processes, *Flash evaporation, *Multiple effect distillation, *Multistage flash distillation, Operating costs.

By analyzing multistage installations for flash evaporation and multiple effect evaporators being operated in the USSR, the product was found to cost more (5 to 8 kopecks) by flash evaporation than by multiple effect evaporation. Three reasons are given for this. (1) In a flash installation, in order to create good heat transfer at the heater-condensers, the total amount of water to be evaporated must be pumped through at a high-rate, which leads to extensive use of electric power and to a unit cost 2 to 3 kopecks more than that with multiunit equipment. (2) An increase of 1 to 1.5 kopecks must be added to the flash installation because of the acid treatment to feedwater to prevent scale formation, and (3) an increase in cost is realized for the flash process because of the larger heating surface. Flash evaporation and natural circulation evaporators have a high operational reliability. Descending film and circulation pumps require constant servicing and overhauling.
W70-04658

DEAERATORS FOR DESALINATION PLANTS.
Oak Ridge National Lab., Tenn.

OSW R and D Progr. Rept. No. 314, Dec. 1967. 117 p, 27 fig, 83 ref.
Identifiers: *Carbon dioxide removal, *Deaeration, *Deaerators, Carbon dioxide analysis, Columns (Process), Corrosion control, Fouling, Freeport plant, Oxygen analysis.

An interim report on the deaerator study is presented outlining the state-of-the-art information on existing deaerators, research and test work performed by OSW contractors and availability of commercial deaerators. Technical literature survey revealed very little information on mass transfer technology related to problems of designing deaerators for seawater. Experimental work by M. W. Kellogg Co. has attempted to evaluate conventional two-phase exchange technology to seawater. Recommendations are made to undertake a test program to evaluate the performance of the most promising deaeration methods.
W70-04659

CURRENT AND PROJECTED TECHNOLOGY OF FLASH TYPE SEA WATER DESALTING PLANTS,
Aqua-Chem, Inc., Milwaukee, Wis.
A. B. Steinbruchel.
Preprint SM-113/29 of Paper Presented at IAEA Symp. Nucl. Desalination, Madrid, Spain, Nov. 18-22, 1968. 12 p, 4 fig.
Identifiers: *Clair Engle plant, *Flash evaporation, *Scale prevention, Brine concentration patio,

Component designs, Corrosion control, Feedwater treatment, Flowsheets, Performance ratio.

Designed and built by Aqua-Chem, Inc., the Clair Engle multistage multieffect flash plant at San Diego, with 3 recycle effects and 68 stages, is operating at a performance ratio better than 20 to 1, a 50% higher gain ratio than any other plant in the world. Guaranteed to operate and produce 1 MGD with a maximum brine temperature of 250 deg F, the equipment is designed for future operation with brine temperatures up to 290 deg F, increasing capacity to 1.23 MGD. Devised primarily to avoid calcium sulfate scaling conditions over a wide range of temperatures while minimizing feedwater quantity and treatment costs, the MEMS process permits operation of the flash plant at both higher brine terminal temperature and higher final brine concentration than other flash evaporator systems. To control and minimize corrosion of evaporator materials the plant operates with a two-stage atmospheric degasification followed by a vacuum deaeration system to liberate corrosive gases from acidified seawater. Flow schemes, plant auxiliary systems, and components are described in detail.
W70-04660

DESIGN AND COST OF ION-EXCHANGE SOFTENING FOR A 50-MGD SEAWATER EVAPORATION PLANT,
California Univ., Berkeley.
G. Klein, K. M. Makar, B. W. Tleimat, and T. Vermeulen.
Sea Water Conversion Lab. Rept. No. 68-2 (Water Resources Center Desalination Report No. 25), September 1968. 59 p, 12 fig, 10 tables, 31 ref.
Identifiers: *Freedwater treatment, *Removal from feedwater, Calcium, *Scale prevention, Capitalized costs, Conceptual designs, Concrete construction, Demineralizers, Ion exchangers, Ion exhanging.

Ion exchange is used for the removal of calcium from seawater, followed by acidification and deaeration to eliminate carbonate ions. Regeneration of the ion-exchange bed is accomplished by using only the reject brine from the evaporator, the brine being concentrated in the evaporation to four times the salinity of seawater. The capital cost of the installation is minimized by assuming the use of open reinforced-concrete tanks, rather than closed steel tanks, for the ion-exchange beds. The designs of the ion-exchange installation and of its operating cycle are based on a body of pertinent experimental data obtained previously in this laboratory. The design study has resulted in an estimated cost for calcium removal of 3.6 or 3.8 cents/1000 gal of product from the evaporator, based on respective interest rates of 3.125 or 4.125% on the depreciated plant investment. Since this pretreatment leads to more economic distillation conditions, the attendant savings should largely offset the costs of pretreatment.
W70-04661

DYNAMICS EXPERIMENTS ON THE AMF MILLSTONE POINT FLASH EVAPORATOR,
Oak Ridge National Lab., Tenn.
S. J. Ball, N. E. Clapp, B. Squires, and R. Van Winkle.
ORNL-TM-2188, July 8, 1968. 69 p, 37 fig, 25 ref.
Identifiers: *Multistage flash distillation, *Plant dynamics, AEC sponsored, Dynamic response, Exerimental data, Frequency response, Instrumentation, Mathematical models.

Dynamics experiments were performed on the three-stage AMF flash evaporation at Millstone Point, Conn., in June 1967 to verify theoretical calculations of large MSF plant dynamic behavior. Frequency response tests were run at operating temperatures between 100 and 140 deg F, tray-brine flowrates between 400,000 and 700,000 lb/hr per foot of width, and with both plain and baffled interstage orifice designs. Pseudorandom binary sequences were used as input perturbation signals for the recirculating brine and brine heater steam flow control valves. The measured results indicate that the fixed-coefficient, single-phase flow orifice equation is inadequate for describing transient interstage orifice flowrates. Improved models were derived for the tray brine vaporization rate and flow dynamics. The scope of the experiments was reduced due to equipment difficulties and to excessively large inherent temperature fluctuations under certain operating conditions.
W70-04662

NUCLEAR DESALINATION PLANT DYNAMICS - MODELING AND ANALYSIS OF A MULTISTAGE FLASH EVAPORATOR,
Tennessee Univ., Knoxville.
T. W. Kerlin, J. W. Prados, W. C. Wright, and E. L. Mohundro.
Neut-2906-2, July 1968. 30 p, 11 fig, 7 ref.
Identifiers: *Evaporation dynamics, *Mathematical models, *Multistage flash distillation, Flow distribution, Fluid dynamics, Stability analysis.

Progress is reported in developing mathematical models for describing tray brine flow in an MSF stage. A scale model of a 5-stage test chamber was constructed, and proposed test procedures and equipment are described. A mathematical model for two-region brine-tray liquid flow is developed, and theoretical results are presented. A summary is given of a method for computing the linear stability of very large systems, with application to a large MSF plant. A detailed description is in NEUT-2806-3 (see abstract 30-00657).
W70-04663

PROBLEMS IN DESIGN AND RESEARCH ON CONDENSERS OF VAPORS AND VAPOR MIXTURES,
Delaware Univ., Newark.
A. P. Colburn.
Inst. Mech. Engrs., London, Proc, Vol. 164, p 448-58, 1951. 14 fig, 36 ref.
Identifiers: *Condensing , *Evaporator system design, *Evaporator-condenser system designs, *Heat transfer, Design, Design data, Feedwater heating, Film condensation, Mass transfer.

The theoretical background is outlined for condensation of pure and mixed vapors under conditions of a film-type condensate. The effect of vapor velocity is important for both pure vapors and those mixed with noncondensable gases. On the basis of the fundamental mechanism of condensation involved, approximation procedures are developed which are useful as quick methods of estimating and rough checking. It is concluded that there is great need for testing theoretical and approximate methods against full-scale performance data.
W70-04664

AN INVESTIGATION ON THE DISTILLATION OF BRINE BY VERTICAL TUBE EVAPORATION UTILIZING THE SEPHTON FLASH TUBE (VORTEX TUBE) PROCESS,
California Univ., Berkeley.
H. H. Sephton.
OSW R and D Progr. Rept. No. 361, June 1968. 44 p, 22 fig.
Identifiers: *Falling film evaporation, *Twisted tapes, Flow control, Heat transfer improvements, Proprietary process.

Design and construction of a vertical tube evaporator (VTE) test facility, capable of testing pairs of distillation tubes of 1- to 3-in. diameter and up to 24 ft in length is described. A novel, proprietary vortex tube process for fluid flow control as applied to falling film flash evaporation and to vertical tube distillation by utilizing a helical insert narrower in width than the internal diameter of such tubes is reported. Heat flux gains of 20 to 80% were obtained with a vortex tube over those obtained with a reference tube, tested simultaneously under equal VTE process conditions with water having 0 to 10% sodium chloride added thereto as the distilland, in vertical copper distillation tubes of 2-in. x 20 ft dimensions.
W70-04665

DEVELOPMENT OF TECHNOLOGY APPLICABLE TO 50 MGD AND LARGER SEAWATER DISTILLATION PLANTS,
Office of Saline Water, Washington, D.C.; and Oak Ridge National Lab., Tenn.
E. N. Sieder, and I. Spiewak.
Preprint SM-113/34 of Paper Presented at IAEA Symp. Nucl. Desalination, Madrid, Spain, Nov. 18-22, 1968. 20 p, 5 fig, 21 ref.
Identifiers: *Component development, *Component testing, *Heat transfer improvements, *Vertical tube evaporators, Brine flow, Component designs, Concrete construction, Deaerators, Entrainment, Extended heat transfer surfaces, Flash chambers, Freeport plant, Heat transfer coefficient, Heat transfer surfaces, Pilot plant operations, Product water treatment, Wrightsville Beach plant.

The San Diego Multistage Flash Module serves as a test bed for studying brine flows up to 1,000,000 lb/hr-ft width in full-scale flash chambers, hydraulics of a 77,000 GPM recycle pump, and heat transfer and venting of large condenser bundles. Low-cost evaporator tubing fabrication methods are being developed, and tubes up to 36 ft long have been fabricated and installed in a test fixture. Deaerator designs and instruments are being developed to reduce oxygen content of treated seawater to 10 ppb. Advanced technology developement is centered around high performance evaporator tubing, especially with the multieffect vertical tube evaporator process. Fluted tube bundles at Wrightsville Beach and Freeport are maintaining heat transfer coefficients 2 to 3 times higher than those of smooth tubes. A new spiral-indented tube provides heat transfer rates 1.5 to 2 times those of smooth tubes. Full size bundles of high performance tubes will be tested in a VTE component test vehicle to be built at San Diego. Concrete is especially promising as a structural material, as tests have indicated that it will withstand brine temperatures up to 250 deg F. Plastics are promising for coatings and for special parts such as hook-vane entrainment separators. Progress is also being made in large water-only plants. Design studies have been completed of large vapor compressors and of large VC plant designs.
W70-04666

CORROSION RESISTANCE OF TITANIUM AND ITS ALLOYS IN PRIMARY WATER AND HOT BRINE ENVIRONMENTS,
Titanium Metals Corp. of America, West Caldwell, N.J.
For primary bibliographic entry see Field 08G.
W70-04667

DEVELOPMENT REPORT NO. 6, SALINE WATER CONVERSION DEMONSTRATION PLANT NO. 1, FREEPORT, TEXAS.
Stearns-Roger Corp., Denver, Colo.

OSW R and D Progr. Rept. No. 298, Sept. 1967. 53 p, 7 fig, 10 tables, 7 ref.
Identifiers: *Deaerators, *Feedwater treatment, *Multiple effect distillation, *Vertical tube evaporators.

The report covers an investigation of the various aspects of heat transfer and feedwater treatment and their effects on the multiple-effect long-tube-vertical evaporator. Development run no. 8 was conducted in a scale-free manner for almost two months with only one unscheduled shutdown of 1.5 hr. Production was maintained above 1 mgd with 69.5% of the originally installed heat transfer surface. Tests were completed which show that product heat recovery by flashing accumulated condensate is feasible, but the existing plant equipment imposes limitations on the maximum production rate in this mode of operation. A study of feed-

water acid addition rate to the deaerator-decarbonator showed that the quantity of acid used could be reduced about 15% without harm. Water was produced for 114.58 cents/1000 gal during the run. This value reflects a 2.69 cents/1000 gal penalty directly attributable to operating conditions imposed by the development program.
W70-04668

DEVELOPMENT REPORT NO. 7, SALINE WATER CONVERSION TEST BED PLANT, FREEPORT, TEXAS.
Stearns-Roger Corp., Denver, Colo.

OSW R and D Progr. Rept. No. 299, June 1968. 59 p, 17 tables, 10 fig.
Identifiers: *Deaerators, *Feedwater treatment, *Multiple effect distillation, *Vertical tube evaporators, Acid stabilization processes, Cathodic protection, Chemical additives, Corrosion control, Freeport plant, pH control, Pilot plant operations, Protective coatings, Removal from feedwater, Carbonate, Scale prevention, Status reports, Water costs actual.

The report covers an investigation of the various aspects of heat transfer and feedwater treatment and their effects on the multiple-effect long-tube-vertical evaporator. Development run no. 9 (June to Nov. 1965) consisted of over 4 months of operation with a total of 31 hours of shutdown time, and 2 of the 4 shutdowns were scheduled as part of the development program. Evaluation of test data indicates that plant insulation is deteriorating and that steam economy is suffering accordingly. Evaporator performance evaluations show that high operating temperatures and high brine flow rates enhance heat transfer coefficients. Investigation of tube side pressure drop in the evaporators has indicated that lost temperature potential due to delta p is a factor in the low pressure evaporators. It was proven that improper venting can limit the production capability of the plant and that venting adjacent effects to the atmosphere through a common line is not adequate. Water was produced for 111.93 cents/1000 gal during the run, a 3% improvement over run 8, due to higher production over a longer operating time.
W70-04669

DESALINATION PLANTS USING HIGHER STEAM PRESSURES,
Catalytic Construction Co., Philadelphia, Pa.
For primary bibliographic entry see Field 08C.
W70-04670

RESEARCH AND DEVELOPMENT ON THE HORIZONTAL SPRAY FILM EVAPORATOR.
Aqua-Chem, Inc., Waukesha, Wis.

OSW R and D Progr. Rept. No. 209, Nov. 1966. 81 p, 33 fig, 9 ref.
Identifiers: *Dropwise condensation, *Heat transfer coefficient, *Horizontal tube evaporators, Scaling, Vapor compression evaporation.

Heat transfer coefficients on horizontal spray film evaporator were determined under a variety of operating conditions under laboratory and field operating conditions. Heat transfer coefficients were only slightly influenced by the heat and vapor velocity over the range of 3000 to 12000 btu/hr sq ft heat flux and 16.5 to 50 ft/sec average vapor velocity. Average heat transfer coefficients of 1125 and 2000 btu/hr sq ft deg F can be maintained for the 5/8-in.-copper-nickel bundle and copper bundle, respectively, on salt water without scaling for an extended period of time under vapor compression operation.
W70-04671

ANALYSIS OF THE ECONOMICS OF LARGE CAPACITY THERMAL DESALINATION PLANTS,
I. L. Sergeyenko.
Proc. 1st Intern. Symp. Water Desalination, Washington, 1965, p 373-88, 1967. 24 fig, Paper SWD/71.
Identifiers: *Distillation processes, *Multistage flash distillation, *Seeding processes, *Vertical tube evaporators, Direct contact heat exchange, Feedwater treatment, Flash evaporation.

The two main processes for large-scale distillation plants are vertical tube evaporation and multistage flash distillation (with either condenser tubes or contact condensation). Scale formation is a basic problem in any of the processes. In USSR the most economical scale prevention method is a seeding process. Numerous graphs are given to show the effect of the number of stages in a plant on the cost of product water for the different distillation processes.
W70-04672

AN EFFICIENT, COMPUTER-ORIENTED METHOD FOR STABILITY ANALYSIS OF LARGE MULTIVARIABLE SYSTEMS,
Tennessee Univ., Knoxville.
W. C. Wright, and T. W. Kerlin.
Ph.D. Thesis. Neut-2806-3, July 1968. 172 p, 27 fig, 88 ref.
Identifiers: *Multistage flash distillation, *Plant dynamics, *Reactor dynamics, AEC sponsored, Frequency response, Programs (Computers), Stability analysis.

The development and application of a technique is described for evaluating the stability of multivariable systems whose dynamics are given by up to 1000 first-order, linear differential equations. Time-lagged variables may be included in these equations. The technique is an analytical approach which operates on the coefficients of the equations that describe the system. The method is based upon a modification of the Mikhailov (Leonhard-Cremer) stability criterion and employs special programming techniques which take advantage of the form of the system equations. Among the systems analyzed for stability were the molten salt reactor experiment, a molten salt breeder reactor, and the evaporator, heater, and heat reject components of a multistage flash evaporator plant. Computer programs written in FORTRAN IV are included. The analysis of the multistage evaporator plant required about 1.5 hr on the IBM 360/75 computer.
W70-04673

CONCEPTUAL DESIGN STUDY OF A ONE MILLION GALLON PER DAY MSM DESALINATION PLANT - REPLACEMENT FOR DEMONSTRATION PLANT NO. 2 AT POINT LOMA, SAN DIEGO, CALIFORNIA.
Fluor Corp., Ltd. Los Angeles, Calif.

OSW R and D Progr. Rept. No. 252, Apr. 1967. 147 p, 28 fig.
Identifiers: *Conceptual designs, *Multiple effect distillation, Concrete construction, Construction costs, Deaeration, Design, Distillation processes, Feedwater treatment, Flash evaporation, Fossil fuels, Point Loma plant, Scale prevention, Seeding processes, Tube bundle design, 0-50 MGD plant.

Results are presented of a conceptual design study are presented for a 1.0-MGD multieffect flash plant at Point Loma. The design is essentially a 1/50th slice of an optimum conceptual 50-MGD plant and is intended to demonstrate major design features. The base plant (68 flash stages) operating temperature is 250 deg F, with flexibility to operate experimentally at 290 deg F. A special 1A effect, to operate independently, is provided to yield operating experience in the 290 to 350 deg F range. The design provides for study of brine flow path variations, measurement of instage temperatures and pressures, and study of concrete shell performance. The vertical height of the effect II and III tube bundles is representative of large-capacity plants. Acid treatment provides alkaline scale control. Auxiliary seeding, lime magcarbonate, and ion exchange systems provide sulfate scale control at extended operating conditions. Capital cost estimates (1965 basis) are $2,950,000 for the base plant, $225,000 for the 1A effect, and $1,170,000 for water treatment systems.
W70-04674

COST OF WATER FROM A SINGLE-PURPOSE MULTISTAGE FLASH PLANT WITH VAPOUR RECOMPRESSION.
Applied Research and Engineering Ltd., Durham (England).

IAEA Tech. Rept. Ser. No. 93, 1968. 73 p, 35 fig, 31 ref.
Identifiers: *Economic evaluations, *Energy sources, *Single-purpose plant economics, *Water costs estimate, Dual-purpose plant economics, Fossil fuels, Gas-cooled fast-breeder reactors, High-temperature gas-cooled reactors, Nuclear energy sources, Pressurized-water reactors, Single-purpose plant.

The cost of water from a single-purpose MSF/recompression plant is presented and compared with the cost of water from dual-purpose plant. It also shows the cost of water from a plant producing both water and power separately from a common reactor. It was found that for a single-purpose plant with recompression the estimated water costs ranged from 30 cents/1000 gal for a 350-MGD plant with a light-water reactor (at 6% charge rate) to 92 cents/1000 gal for a 70-MGD plant with a gas-cooled reactor (at 15% charge rate). Estimates are given for 70 and 350-MGD plants, 6 and 15% charge rates, and light-water reactors, fast reactors, gas-cooled reactors, high-pressure steam fossil plants, and low-pressure fossil plants. A direct comparison between the proposed system and a dual-purpose plant cannot be made because of the effect of the cost of electrical power on the water cost from a dual-purpose plant.
W70-04675

THERMAL DISTILLATION OF SEA WATER - FUNDAMENTALS OF THE THEORY OF MARINE EVAPORATORS,
V. F. Kovalenko.
AEC-TR-6893, Sept. 1967. 230 p, 155 ref. Translated from Russian, Transport Publishing House, Moscow, 1966.
Identifiers: *Distillation processes, Energy sources, Flash evaporation, Heat transfer, Physical chemistry of scale, Scale prevention, Thermodynamics.

This translation of the Russian book covers distillation for use aboard ships, mostly theory and background. The chapters are: (1) Fundamentals of thermal distillation, (2) Sources of heat and selection of types of shipboard evaporator installations, (3) Fundamental principles of the theory of heat exchange in thermal distillation, (4) Methods of reducing the thermal resistance of the scale in marine evaporators, (5) Fundamentals of design and calculation in thermal distillation, (6) Automation of thermal distillation on ocean vessels, (7) Ways of increasing evaporator efficiency.
W70-04676

SEA WATER DESALINATION BY THE FALLING-FILM PROCESS,
Office of Saline Water, Washington, D.C.
D. I. Dykstra.
Chem. Eng. Prog. Vol. 61, No. 7, p 80-88, 1965. 12 fig, 15 ref.
Identifiers: *Falling film evaporation, *Freeport plant, *Vertical tube evaporators, Distillation processes, Feedwater heating, Heat exchangers, Heat transfer, Heat transfer improvement, Heat transfer surfaces, Multiple effect distillation, Pilot plant operations.

A description is given of the operation of various heat transfer units in the first OSW desalination demonstration plant (built 1960-61 at Freeport, Texas). The plant is of the long tube vertical (LTV)

falling-film type with forward feed and 12 evaporator effects. Boiler plant steam supplies heat in the first effect. Most of the feedwater evaporated in the first effect heats and evaporates the feedwater in the second effect evaporator, being condensed by this process, and the remainder is condensed as it gives up its heat to the incoming feedwater. The discharged brine from the first effect becomes the feed for the second effect. This process is repeated in 11 additional evaporator effects at progressively lower temperatures and pressures down to 115 deg F and 1.9 PSIA in the twelfth effect. The evaporated water from the last effect is condensed by heat exchange with seawater. For every pound of steam 11 lb of fresh water are produced. Electric power consumption is about 1 kw-hr/1000 lb of fresh water production. Total energy consumption is about 115 btu (thermal)/lb of water produced. Operating temperatures have been successfully increased to 278 deg F and overall plant temperature range to 160 deg F. Equivalent production rates of 180% of rated capacity have been demonstrated. Work is continuing with the anticipation of reaching and exceeding 300 deg F operation.
W70-04677

FLOW THROUGH IRRIGATED DUMPED PACKINGS--PRESSURE DROP, LOADING, FLOODING,
M. Leva.
Chem. Eng. Progr. Symp. Ser. , Vol. 50, No. 10, p 51-59, 1954. 10 fig, 21 ref.
Identifiers: *Columns (Process), *Deaeration, *Deaerators, Aeration, Carbon dioxide removal, Feedwater treatment, Removal from feedwater, Carbonate.

Loading and flooding in packed irrigated towers and the relation of these phenomena to pressure drop are discussed. Empirical equations which permit pressure-drop estimations in the preloading range are given, and extensions of these equations to liquids other than water are made. In order to estimate the pressure drop in the loading-flooding zone, for which the equations will give low results, a generalized isobaric plot was prepared. The graphical presentation includes most of the loading data in the literature, and the chart indicates not only the state of loading of an irrigated tower but also the expected pressure drop. The correlation of the data pertaining to water, sucrose solution, and oils led to a slight modification of the generally accepted flooding correlation. Analysis reveals that incorporation in the ordinate of the density ratio of water to that of the irrigating liquid considerably improves the presentation of the data.
W70-04678

OPERATING EXPERIENCE AT THE MULTI-STAGE FLASH DEMONSTRATION PLANT, POINT LOMA, CALIFORNIA,
Westinghouse Electric Corp., Philadelphia, Pa.
R. E. Gaunt.
Water Production Using Nuclear Energy (Ed. by R. G. Post and R. L. Seale), p. 135-44, 4 fig, Univ. Arizona Press, Tucson, 1966. Proc. Am. Nucl. Soc. Symp., Mar. 1966, Tucson, Ariz.
Identifiers: *Operating experience, *Point Loma plant, Feedwater treatment, Multistage flash distillation, Pilot plant operations, Scale prevention, 0-50 MGD plant.

The 1-MGD, 36-stage flash evaporator demonstration plant operated from Nov. 1961 until early 1964. At this time it was dismantled and reassembled at the Guantanamo Naval Base in Cuba. A brief description of the plant and its demonstration features is given. Operation of the plant was quite satisfactory with mechanical difficulties, confined mostly to pumps and peripheral equipment, causing some interruptions during the first year of operation. Initial operation was with polyphosphate feedwater treatment which permitted operation at 200 deg F. A change to an acid treatment system permitted operation at 250 deg F and it was possible to increase the production rate to 1.4 MGD. Experience at Point Loma and other installations allows some confident predictions to be made about the future costs of producing potable water by the multistage flash process. Product cost was about $1.25/1000 gal when operating at 200 deg F but this dropped to about $1.00/1000 gal when the production rate was increased to 1.4 MGD. Studies show that with present-day technology large amounts of water can be produced for 25 to 35 cents/1000 gal in large dual-purpose plants.
W70-04679

CORROSION IN CARBON STEEL HEAT TRANSFER SURFACES,
Midwest Research Inst., Kansas City, Mo.
E. P. Shea, and W. R. Hollingshad.
OSW R and D Progr. Rept. No. 166, Dec. 1965. 129 p, 243 fig, 38 tab.
Identifiers: *Carbon steels, *Pitting (Corrosion), *Tubing (Metal), *Wrightsville Beach plant, Aeration, Corrosion, Corrosion tests, Deaeration, Heat transfer, pH control, Physical chemistry of scale, Pilot plant operations, Scaling, Seawater chemical analysis, Temperature control.

Results are described from operation of two distillation pilot plants at Wrightsville Beach to investigate effects of dissolved oxygen, pH, heat transfer rates and tube surface condition on corrosion of carbon steel evaporator tubes in seawater at temperatures to 250 F. It was concluded that steel tubes are not suitable for evaporator effects above atmospheric boiling. However, decarbonation and deaeration are essential for inhibiting scale formation and minimizing corrosion. Seawater pH should be maintained above 8. Greater corrosion was experienced at pH 7 than at pH 8. Tube surface condition had no appreciable effect on corrosion. The rate of heat transfer did affect corrosion. Greater corrosion occurred at the higher heat transfer rates unless scale formation inhibited attack. Scale formation was a problem at the higher Delta temperatures. At Delta temperatures of 12-16 F, scale formation was accelerated. Complete tabular data are presented for aerated and deaerated seawater systems on corrosion rates, tube penetrations, scale weights and analyses, and composition of Wrightsville Beach seawater.
W70-04680

ANALYSIS AND OPTIMIZATION OF A MULTIEFFECT MULTISTAGE FLASH DISTILLATION SYSTEM - PART I. PROCESS ANALYSIS,
Kansas State Univ., Manhattan.
L. T. Fan, C. Y. Cheng, C. L. Hwang, L. E. Erickson, and K. D. Kiang.
Desalination Vol 4, p 336-60, 1967, 13 ref. Also part of special Report No. 74, Kansas Engineering Experiment Station, Manhattan, Kansas (1967).
Identifiers: *Mathematical models, *Multiple effect distillation, *Multistage flash distillation, Design, Distillation processes, Heat balance, Material balance.

A mathematical model of a multieffect multistage flash distillation system that can be used in process optimization studies is developed. The model enables the heat input to the brine heater, the recycle flow rate in each effect, the concentration and temperature of the flashing brine leaving each effect, and the number of stages in each effect to be treated as variables in an optimization study. The model is believed to be accurate enough to describe the process, yet simple enough to be used in the simulation, design, and optimization of the process.
W70-04681

ANALYSIS AND OPTIMIZATION OF A MULTIEFFECT MULTISTAGE FLASH DISTILLATION SYSTEM - PART II. OPTIMIZATION,
Kansas State Univ., Manhattan.
L. T. Fan, C. Y. Cheng, C. L. Hwang, L. E. Erickson, and K. D. Kiang.
Desalination Vol. 4, p 361-88, 1968. 13 fig, 14 ref. Also Part of Special Report No. 74 Kansas Engineering Experiment Station, Manhattan, Kansas, 1967.
Identifiers: *Mathematical models, *Multiple effect distillation, *Multistage flash distillation, Design, Distillation processes, Heat balance, Material balance.

A mathematical model of a multieffect, multistage flash distillation system that can be used in process optimization investigations has been developed in Part I of this work. In the present part, the model is used together with an economic model of the system to minimize the cost of water production. The heat input to the brine heater per unit of feed, the recycle flow rate in each effect, and the concentration and temperature of the flashing brine leaving each effect are chosen so that the water production cost is a minimum.
W70-04682

CONCEPTUAL DESIGN STUDIES OF A DUAL-PURPOSE AND A VAPOR-COMPRESSION WATER-ONLY 750-MGD PLANT,
Oak Ridge Gaseous Diffusion Plant, Tenn.; and Office of Saline Water, Washington, D.C.
S. J. Senatore, and E. N. Sieder.
Preprint SM-113/33 of Paper Presented at IAEA Symp. Nucl. Desalination, Madrid, Spain, Nov. 18-22, 1968. 12 p, 5 fig, 3 ref.
Identifiers: *Conceptual designs, *Dual-purpose plant, *Heavy-water/organic-cooled reactors, *Single-purpose plant, *Southwest United States, Fixed charge rate, Municipal financing, Performance ratio, Turbine-generators, Vapor compression evaporation, Vertical tube evaporators, Water costs estimate, 250 plus MGD plant, 3000 plus MW (T) reactors.

To determine their potential for meeting long-range water and power requirements of the southwestern U. S., conceptual designs and cost estimates were prepared for a water-only and a dual-purpose plant, both with fresh water capacities of 750 MGD. The single-purpose plant consists of a 3962 MWT heavy-water moderated organic-cooled reactor coupled to a vapor compressor, vertical tube evaporator plant and is designed for a performance ratio of 20.40 lb product/1000 btu and 250 deg F maximum brine temperature. The dual-purpose plant consists of a 10,027 MWT HWOCR designed for a performance ratio of 10.47 product/1000 btu and for a maximum brine temperature of 250 deg F. Auxiliary power requirements at the site are estimated to require 275 MWE, leaving 1870 MWE available for sale and offsite product water conveyance. Based on municipal-type financing, with an annual fixed charge rate of 6.597%, the average cost of product water from the single-purpose plant at the plant boundary is estimated at 22.24 cents/1000 gal and at 18.47 cents/1000 gal for the reference dual-purpose plant.
W70-04683

ENGINEERING AND ECONOMIC EVALUATION STUDY OF REVERSE OSMOSIS,
Kaiser Engineers, Oakland, Calif.
F. L. Harris, G. B. Humphreys, H. Isakari and G. Reynolds.
Office of Saline Water Research and Development Report 509, 1969. 505 p. OSW Contract 14-01-0001-1669.

Descriptors: *Desalination, *Reverse osmosis, *Membrane processes, Cost optimization, Plant design.
Identifiers: *Desalination apparatus, Membranes, Computer algorithm, Economics.

A parametric engineering and economic analysis of the reverse osmosis process was performed in which water costs were examined for demineralizing feedwaters with salinities of 2000, 3000 and 5000 ppm in plant sizes of 1, 10 and 50 mgd capacity, product water recoveries of 50, 60 and 80%, and operating pressures of 400, 600 and 800 psi. Capital and operating costs were prepared using state-of-the-art technology for tubular, plate-and-frame, spiral wound, and hollow fine fiber reverse osmosis plant design concepts. Mathematical

models were prepared to represent the hydrodynamic characteristics of each design concept. These models, in conjunction with computer codes were used to optimize plant design and operating parameters. Plant capital and operating costs were also prepared on the basis of anticipated improvements in reverse osmosis technology. (Mintz-Office of Saline Water)
W70-04889

VACUUM FREEZING VAPOR COMPRESSION PROCESS: EVALUATION ON BRACKISH WATER,
Colt Industries, Inc., Beloit, Wis.
M. M. Jhawar, and J. H. Fraser.
Office of Saline Water, Research and Development Progress Report No. 541, April 1970. 46 p. OSW Contract 14-01-0001-967.

Descriptors: *Desalination processes, *Freezing, Brackish water.
Identifiers: *Vacuum freezing, Mobile unit.

A mobile vacuum freezing vapor compression (VFVC) pilot plant was designed, built and operated at its design capacity on both sea and brackish water. Tests were conducted at Roswell, New Mexico on 15,000 ppm well water. This water was very high in calcium sulfate. No scaling or precipitation were observed. Based on this work it is concluded that the VFVC process can be used to desalt any brackish water without the necessity of pretreatment.
W70-04890

DISPOSAL OF BRINE BY SOLAR EVAPORATION: LABORATORY EXPERIMENTS,
New Mexico State Univ., University Park.
For primary bibliographic entry see Field 05E.
W70-04891

DISPOSAL OF BRINE BY SOLAR EVAPORATION: DATA,
New Mexico State Univ., University Park.
For primary bibliographic entry see Field 05E.
W70-04892

RELATIONSHIP BETWEEN STORAGE CAPACITY AND LOAD FACTOR OF A DESALINATION PLANT,
Department of Economic and Social Affairs (UN).
A. R. Golze.
Proc, Int Seminar Econ Appl Water Desalination, p 185-205, September-October 1967. 21 p, 9 fig, 2 tab.

Descriptors: *Storage capacity, *Desalination plants, Optimization, Load distribution, Water supply, Computers, Models, Costs, Economics, California, Programs.
Identifiers: Storage facilities.

Relationships involved in comprehensive studies to determine the economic selection between alternative water supplies were discussed. Several typical situations in which a desalter might be justifiably involved in water supply and the utilization of its output were analyzed. The case where the desalter was the sole source of supply was selected to illustrate the type of optimization that could be accomplished. The relationship between storage capacity and the desalting plant load factor was derived and programmed for computer solution. An optimization model was developed and used to determine the operation of the desalination plant. A discussion of different types of storage facilities and of representative average cost of such storage facilities in California was presented. (Thiuri-Cornell)
W70-04905

ENGINEERING ASPECTS OF A NUCLEAR DESALTING PLANT,
Burns and Roe, Inc., New York.
J. G. Perri.
J. Power Div., Am. Soc. Civil Engrs., Vol 93 (PO1), p 31-50, 1967.
Identifiers: *Modular construction, Dual-purpose plant, Flash chambers, Flash evaporation, Layout, Multistage flash distillation, Nuclear desalination.

The dual-purpose plant is a transformation of the simple nuclear power and desalting plants but contains new elements conceptually different from the analogous elements in those simple plants and has special characteristics which greatly affect the design. One of the most important characteristics is the multistage controlled evaporator, that is, the complex of stages vertically assembled containing thin film evaporators. The problem posed by the modular concept required considerable study and technical background, the resulting coordinate procedure for the general assembly of the modules will produce a vessel-structure concept. The structural system is a central feature of great interest. Basically, it can be classified as an orthotropic plate system, however, its dual function of being a pressurized vessel and a supporting structure makes it an unusual engineering project.
W70-04925

FLASH DESALINATION PLANT - THE RESULTS OF THE FIRST TEN YEARS OF DEVELOPMENT AND FIELD PROVING,
Buckley and Taylor Ltd., Oldham (England).
W. Smith.
Water Eng. Vol. 69 (837), p 458-62, 1965. 5 fig.
Identifiers: *Distillation processes, *Reviews, Corrosion control, Instrumentation, Product ratio, Pumps, Scale prevention, Water utilization.

A variety of field-proved designs are currently available, providing a wide range of sizes of distillation plants with outputs from 2000 GPO to nearly 2 MGD. Considerable variation in performance ratio is available within the range 1.5/1 to 8/1, allowing the user a measure of control over the cost of the converted water. Perhaps the most significant proved application available today is the dual-purpose plant, since there is generally a need for increased power wherever there is a need for more water. In ten years the total of land-based distillation capacity has increased from 8 MGD to 40 MGD. Currently, the largest single unit operating commercially is about 1.5 MGD. However, design thought should be given to 50 to 150 MGD plants. Work is now in progress to study such problems as scale suppression techniques, corrosion/erosion prevention, automatic controls, and pumping problems. In many cases we cannot afford to wait for the final lowest cost water. Users and manufacturers should acknowledge that assessing future massive demands for water and large-scale conversion will only come several years hence. The world is thirsty now and this thirst must be quenched with water conversion equipment of present-day field-proved design.
W70-04926

INVESTIGATION OF WATER STEAM DROP CONDENSATION CONDITIONS,
L. A. Minuhin, V. B. Chernozubov, E. P. Emelina, A. A. Bolotov, and Z. M. Romanova.
Desalination, Vol 2, p 337-44, 1967. 4 fig, 6 ref. Also preprints from 2d European Symp.-Fresh Water from the Sea, Vol 2, Athens, May, 1967.
Identifiers: *Chemical additives, *Condensation promoters, *Dropwise condensation, Film condensation, Heat transfer coefficient, Heat transfer improvements.

Silicoorganic hydrophobizing liquids, copper and chrome oleates, machine oil, and paraffin were tested as dropwise condensation promoters. In the runs, copper, brass, and copper-nickel tubes of 8-40 MM OD and 0.3-5 M lengths were used. The runs were made with condensing steam under atmospheric pressure, introducing the promoter on the heating surface by bubbling steam through a solution of the promoter. Conclusions reached were (1) in the condensation of commercially polluted steam, promoter life is sharply reduced in comparison with its life using pure steam, (2) the reason for this reduction is the deposition of impurities of insoluble particles from polluted commercial steam on the hydrophobic surface, (3) continuous stable dropwise condensation is obtained by the continuous dosage of promoter as well as by periodical dosage at intervals in which good dropwise condensation is still maintained, (4) in the creation of dropwise condensation, decrease of drop size of a promoter in the steam permits use of smaller promoter doses, and (5) there is a definite range of optimal promoter concentrations in the bubbler at which the highest intensity of heat exchange at minimum promoter doses is obtained.
W70-04927

TEST OF THE PILOT DESALTING PLANT WITH RECIRCULATING SEED,
V. B. Chernozubov, E. P. Novikov, V. V. Kartovski, S. I. Golub, and V. G. Shatsillo.
Preprint from 2d European Symp.-Fresh Water from the Sea, Vol 2, Athens, May, 1967. 6 p, 1 fig.
Identifiers: *Seeding processes, *Chemical additives, Distillation processes, Feedwater treatment, Flash evaporation, Heat transfer coefficient, Multistage flash distillation, Pilot plant operations, Scale prevention, Scaling.

With water from the Caspian Sea, which has approximately the same composition of scale-forming ingredients as the ocean, tests were conducted in a small pilot flash plant to determine optimum conditions for scale prevention by the seeding process, which is simpler and less expensive than the more commonly used acidification. The plant consisted of a seven-stage flash evaporator, a main heater and a clarifier. Common ground chalk was used as the seeding agent. In the first series of experiments the seawater was heated to 115 and 125 deg C, and scale formation was retarded but not eliminated. Scale deposited intensively in the main heater and more formed on the exit parts of the tubes than on the entrance parts. The heat transfer coefficient was reduced by 50 to 60%. A second series of tests conducted with seawater heated to 95 and 105 deg C proved 95 deg to be the most practicable, although some problems were encountered due to water foaming in the stages. At 105 deg the heat transfer coefficient remained constant for the whole test period, but a thin film of scale formed on heating tubes. Experiments will be continued in an effort to develop operating conditions and seed composition which will provide scale-free heat exchange surfaces at higher seawater temperatures.
W70-04928

ALLOY SELECTION FOR HEAT-EXCHANGER SERVICE IN SEAWATER-CONVERSION PLANTS,
Battelle Memorial Inst., Columbus, Ohio.
For primary bibliographic entry see Field 08G.
W70-04929

CONTROL OF ALKALINE SCALE USING CARBON DIOXIDE SUPPRESSION,
Oak Ridge National Lab., Tenn.
C. C. Littlefield, D. M. Eisenbert, and S. A. Reed.
ORNL-TM-2415, March, 1969. 34 p, 11 fig, 11 ref.
Identifiers: *Feedwater treatment, *Removal from feedwater, Carbonate, *Scale prevention, Bench scale, Carbon dioxide addition process, Carbon dioxide removal, Distillation processes, Experimental data, Seeding processes.

An investigation into the use of carbon dioxide for preventing scale in distillation-type desalination plants is in progress. Small-scale experimental work has been carried out with seawater in a 6-in.-dia combined flash decarbonator and scale precipitator in Wrightsville Beach and with fresh and salt water in 2-in.-dia countercurrent gas-liquid stripping columns in Oak Ridge. The experimental work has shown (1) that scale can be prevented in brine heater tubes by injecting carbon dioxide into cold brine prior to heating, (2) that the carbon dioxide may be removed by countercurrent

stripping of the hot carbonated brine with either air or steam, and (3) that the alkaline scale which precipitates upon removal of the carbon dioxide can be preferentially collected on solid surfaces such as the stripping column packing or on a high-surface-area solid such as activated alumina. The alkalinity of the exit seawater from the decarbonator has been reduced from the inlet value of about 110 ppm to as low as 20 ppm equivalent calcium carbonate. Further testing is required to define the design parameters for large desalination plant scale suppression systems.
W70-04930

TITANIUM TUBES NOW FIGHT SEA WATER,
Harvey Aluminum, St. Croix, Virgin Islands.
For primary bibliographic entry see Field 08G.
W70-04931

A NEW RIVAL FOR FLASH DISTILLATION,
J. P. Lynam.
Power, Vol 112, No 9, p 79, 1968.
Identifiers: *Vapor compression evaporation, *Water costs estimate, Distillation processes, Economic evaluations, Multistage flash distillation, Proposals, Roswell Plant.

The vapor compression method for water desalting has not had the study it deserves. An OSW study of a 1-MGD plant lists water costs as $1,20/1000 gal for flash distillation, $1.35 for falling-film evaporation, and $1.57 for vapor compression. The study considers electrical power for vapor compression at 1 cent/KWH. However, an on-site diesel generator can provide power for less than half this figure. Also waste heat from such a diesel engine could be used to produce 43% additional product water. This would bring the product cost by vapor compression down to $0.98/1000 gal. It is unfortunate that these simple modifications were not incorporated into the Roswell Vapor Compression Plant. A gas-turbine vapor compression unit might lead to further cost reductions. We should reconsider the supposedly uneconomic vapor compression process in a new light.
W70-04932

DESIGN AND ECONOMIC STUDY OF A GAS TURBINE POWERED VAPOR COMPRESSION PLANT FOR EVAPORATION OF SEAWATER,
Struthers Energy Systems, Inc., Warren, Pa.; and Pratt and Whitney Aircraft, East Hartford, Conn.
H. Wightman, E. G. Rorstrom, F. C. Standifor, C. A. Bassilakis, and R. W. Foster-Pegg.
OSW R and D Progress Report No. 377, July, 1968. 292 p, 46 fig, 12 ref.
Identifiers: *Extended heat transfer surfaces, *Gas turbines, *Vertical tube evaporators, *Waste heat boilers, Compressors, Conceptual designs, Design, Direct costs, Economic evaluations, Falling film evaporation, Heat recover, Single-purpose plant economics.

The study of two sizes of gas turbine drivers was conducted and a 12,500 SHP, dual shaft, gas turbine driver was chosen as the main power train. The plant is designed to produce 8.0 MGD. The cycle uses a VTE and a MSF unit in series. The gas turbine driven axial flow vapor compressor operates across 4 effects of the VTE. Gas turbine exhaust heat is recovered in a heat recovery boiler. Only on-site power is generated in the back pressure turbine rated for 1500 kw. The water cost developed for the plant is $.39/1000 gal. The total capital cost of the plant is approximately $7,500,000. Drawings showing VTE tube sheet configurations and general outlines are provided. A heat and material balance is provided. Vendors bids received for plant equipment are provided.
W70-04933

EXPERIENCES WITH LARGE SEAWATER FLASH EVAPORATORS,
Technische Hogeschool, Delft (Netherlands).
FCAA Van Berkel, J. W. Van Hasselt, and J. H. Van der Torren.
Proc. Intern. Symp. Water Desalination, 1st, 1965, Washington 3, 189-212 (1967), 9 fig, 7 tables, 8 ref, paper SWD/94.
Identifiers: *Design data, *Flash evaporation, *Operating experience, Flowsheets, Layout, System descriptions.

The sources of information are the once-through evaporator of the Compania Shell de Venezuela refinery at Cardon, Venezuela, two brine recirculation evaporators of the government waterworks off the Island of Curacao (Netherlands Antilles), and the brine recirculation-distillate reheat evaporator of the Shell Curacao N.V. Refinery at Emmastad, Curacao. Flow diagrams and design data of the three evaporators are given. The specific heat consumption immediately after cleaning the evaporators was 5 to 15% higher than the design value (which already included a margin for fouling). The experiments showed that temperature indicator pockets should be installed in every flash chamber and in every water box to indicate poorly working flash chambers or condensers and pressure indicators should be installed in each stage to locate noncondensible gases.
W70-04934

COMBINED RECOVERY OF POTABLE WATER AND SEA SALT BY EVAPORATION an economic solution,
T. Messing.
Proceedings, 1st Intern. Symp. Water Desalination, 1965, Washington paper SWD/96, p 573-94, 1967. 12 fig, 4 tables, 11 ref.
Identifiers: *Economic evaluations, *Evaporators, Capitalized costs, Flash evaporation, Operating costs, Scale prevention, Scaling, Water costs estimate.

The operating conditions and a flow diagram of a messo desalting plant incorporating a 3-stage forced circulation evaporator installed in Kuwait (as a subsequent stage to a flash evaporation plant) are given. Scaling by calcium sulfate can be avoided either by chemical treatment of the preconcentrated seawater or by controlled precipitation of the calcium sulfate, using seeding techniques, during further concentration. The results of solubility isotherm investigations of salt in seawater of the Mediterranean at 40, 60, 80 and 100 deg C are given. The most efficient plants were found to be forced circulation evaporators of 10 to 20 stages and flash evaporators of 30 to 40 stages. After two years of operating the Messo plant (potable water output of 272 tons per day), it was found to operate according to design specifications. Total capital costs for an 8-stage flash crystallization plant for the recovery of salt are $7,254,000, including working capital costs of $350,000 for 60 days production. Potable water can be produced at a price ranging between DM 0.40 and DM 0.80 per cubic meter if the production costs come to DM 30 per ton sodium chloride and if a sales price of DM 70 per ton sodium chloride is calculated.
W70-04935

THERMOECONOMIC DESIGN UNDER CONDITIONS OF VARIABLE PRICE STRUCTURE,
Dartmouth Coll., Hanover, N.H.
M. Tribus, and R. B. Evans.
Proceedings, 1st Intern. Symp. Water Desalination, 1965, Washington, p 699-720, 1967. 6 fig., 4 tables, 18 ref.
Identifiers: *Distillation processes, Dual-purpose plant, *Economic evaluations, Energy costs, Thermodynamics, *Water costs estimate.

The costs of condensation-evaporation in a thermal or mechanical distillation system for seawater are 19.5 and 23.8 cents/1000 gal, respectively. The cost of electrodialysis for brackish water is 9.9 cents/1000 gal and for seawater is 80 cents/1000 gal. The cost of reverse osmosis is 32.2 cents/1000 gal. Figures indicate that the cost of steam (in a dual-purpose plant) drawn directly from a boiler (or superheater) is relatively independent of temperature over the range of steam temperatures normally occurring in power plants. The price structures for a linear plant with a fixed external price structure, for a liner plant with variable unit area cost, and for a plant with nonlinearity and variable price structure are given.
W70-04936

OPERATION OF THE 16-STAGE HIGH-TEMPERATURE FLASH PILOT PLANT,
Baldwin-Lima-Hamilton Corp., Eddystone, Pa.
R. A. Tidball, A. N. Rogers, G. Levite, and R. E. Woodbury.
OSW R and D Progress Report, No. 288, Oct., 1967. 106 p, 26 fig, 9 ref.
Identifiers: *Pilot plant operations, *Scale prevention, Blowby, Chemical additives, Flash evaporation, Heat transfer coefficient, Protective coatings, Scale removal, Scaling, Seeding processes, Tubing (Metal), Turbulence promoters.

Operation as a module of a typical commercial plant has confirmed the existence of a kinetic effect in the formation of calcium sulfate scale. The severe conditions imposed by this method of operation cause rapid changes in the heat transfer coefficient, permitting incipient scaling to be detected in a short run. A criterion is given to evaluate scale formation by means of changes in heat transfer coefficients, and a computer method was developed to calculate and plot these changes. Several commercial scale-prevention additives were tested. Some appeared to actually accelerate the deterioration of the heat transfer coefficient. Two of the additives may be of value and further tests should be made. Turbulence creators increased the heat transfer rate as predicted but they did not prevent scale. Tests are planned on a seeding process for scale prevention. Preliminary tests were made on protective coatings for steel. The more promising materials will be evaluated further.
W70-04937

RECYCLE BOOSTS DESALTING EFFICIENCY,
G. E. Weismantel.
Chem. Eng., Vol. 75, No. 15, p 86-88, 1968. 1 fig.
Identifiers: *Clair Engle Plant, Brine flow, Brine system designs, Flowsheets, Multiple effect distillation, Multistage flash distillation, System descriptions, Water costs estimate.

The process flowsheet and a brief process description are given for the Clair Engle Plant (dedicated in 1967). The plant was designed and built by Aqua-Chem for the OSW. It is a multistage multieffect facility with 3 effects and 68 stages. The first 2 effects have 23 stages each and the last has 22. Brine recirculation and long-tube design are major reasons for the high efficiency of the plant. The flow sheet indicates a product rate of 1 MGD operating at a maximum temperature of 250 deg F or 1.25 MGD at 290 deg F. OSW has not released a product cost figure, but it should be around 60 cents/1000 gal. New feedwater treatment facilities could reduce this by as much as 25%.
W70-04938

CONCEPTUAL DESIGN STUDY OF A 1-BGD MULTISTAGE FLASH DISTILLATION PLANT WITH TWO-LEVEL BRINE FLOW,
Oak Ridge National Lab., Tenn.
S. J. Senatore, and J. A. Smith.
ORNL-4201, Oct., 1968. 90 p, 21 fig, 4 ref.
Identifiers: *Multistage flash distillation, Conceptual designs, Concrete construction, Construction costs, Cost breakdowns, Deaerators, Flash chambers, Horizontal tube condensers, Instrumentation, Multilevel plants, Structural designs, Water costs estimate, 250 plus MGD plant.

The report presents the findings and conclusions of a conceptual design study of a 1-BGD MSF desalination plant for a hypothetical gulf of California location in 1975-1980. The desalting plant is coupled to two 5000-MWT boiling-water reactors through a backpressure turbine. The design uses a two-level brine recycle system with fifty flash evaporator stages, a flashing brine temperature

range of 250 degree F to 102.5 degree F, and a product water discharge temperature of 90 degree F. The evaporator shell is constructed of steel in the stages where the temperature is above 200 deg F and of steel-lined concrete below 200 deg F. The evaporator tubing is 90/10 copper-nickel with 0.035-in.-thick wall in the heat recovery section and 0.049-in.-thick wall in the heat reject section. The long-tube concept is used with two tube bundles of approximately 240 ft each in the heat recovery section. A two-stage spray deaerator and conventional sulfuric acid treatment is used for the makeup seawater. The total plant capital cost is $462,799,300 or $0.463 per daily gallon of capacity. Product water cost is estimated to be $0.169/1000 gallons.
W70-04939

ANALYSIS, DATA CORRELATION, AND OPTIMIZATION OF THE VAPOR REHEAT LIQUID-LIQUID HEAT EXCHANGE PROCESS,
Research Triangel Inst., Durham, N.C.
J. C. Orcutt, F. G. Mixon, and D. R. Whitaker.
OSW R and D Progress Report No. 198, Nov 1966. 61 p, 11 fig, 36 ref.
Identifiers: *Direct contact heat exchange, *Heat transfer, Brine heaters, Component designs, Computerized designs, Experimental data, Feedwater heating, Fluid flow, Heat exchangers, Thermodynamics, Vapor reheat processes.

An experiment to determine the effect of oil and water mixing on heat transfer efficiency is described. It is shown that the resistance to heat flow to individual oil droplets contributes a negligible component to the overall resistance in comparison to the large decrease in the effective thermal driving force caused by fluid mixing. A quantitative relationship between the apparent and effective number of heat transfer units is presented to illustrate the effect of mixing as represented by the peclet number for the tower. A formula to calculate the peclet number is derived from the experimental data and is recommended for use in designing spray towers of large diameters. The procedure for using mixing parameters in spray tower heat exchangers is described. The vapor reheat distillation process with liquid-liquid heat exchange has been simulated mathematically and incorporated into a computer procedure which determines the best design-operation policy for a given process configuration. This procedure should be of value in planning development work, as effects of new technology can be readily studied. The 1956 OSW cost procedure is used.
W70-04940

CONCEPTUAL DESIGN STUDY OF A 250 MILLION GALLONS PER DAY COMBINED VERTICAL TUBE-FLASH EVAPORATOR DESALINATION PLANT,
Oak Ridge National Lab., Tenn.
E. C. Hise, and S. A. Thompson.
OSW R and D Progress Report, No. 391, Aug., 1968. 200 p, 54 fig, 39 ref.
Identifiers: *Conceptual designs, *Multistage flash distillation, *Vertical tube evaporators, Capitalized costs, Component designs, Design, Design criteria, Flowsheets, Layout, Specifications, System descriptions, Water costs estimate, 51-250 MGD plant.

The conceptual design of a 250-MGD desalting plant combining a multistage flash feed heater with vertical evaporator effects in which tubes with fluted surfaces are used to obtain heat transfer performances significantly higher than those usually obtained with smooth tubes. The plant is contained in two trapezoidal reinforced-concrete structures, each housing two independent trains. The 15 vertical-tube effects are located above the 50 MSF stages. The vertical tubes condense 83% of the product water for the total plant output- the horizontal feed-heater-condenser tubes condense the other 17%. The overall plant performance ratio is 13. The estimated capital cost for the plant is 30 cents per daily gallon, and the estimated product cost is 12.9 cents/1000 gal. These costs are on a 1965 basis and apply to a follow-on plant - that is, it is assumed that a prototype plant had been built earlier. A cost review of the design by the Bechtel Corp., for a prototype plant and in 1967 dollars, indicated a capital cost of 38.3 cents per daily gal.
W70-04941

OPERATING EXPERIENCES AT THE OSW COAST TEST FACILITY, WRIGHTSVILLE BEACH, NORTH CAROLINA,
W. L. Barnes, and W. J. Hahn.
Water Production Using Nuclear Energy, Proc. AM. Nucl. Soc. Symp., Mar., 1966, Tucson, (Ed. by R G Post and R L Seale), P. 161-74, 1 fig, 4 ref, Univ. Arizona, Press, Tucson (1966).
Identifiers: *Pilot plant operations, *Wrightsville Beach plant, Chemical by-products, Chemical corrosion control, Distillation processes, Feedwater treatment, Fertilizer, Flash evaporation, Freeze processes, Hydrate processes, Multistage flash distillation, pH adjustment, Scale prevention, Seeding processes, 0-50 MGD plant.

A summary of test results on the following equipment, (1) a plant containing 2 effects of a proposed multi-effect evaporator, the first effect containing tubes with a fluted surface on the condensate side and a plane surface on the seawater side, and the second effect with double fluted tubes, (2) an LTV plant to work on the seeding techniques for prevention of calcium sulfate scale at elevated evaporating temperatures, (3) a 6-stage flash distillation plant for scale control tests using seeding techniques, (4) a 10,000-GPD seawater descaling plant designed to remove essentially all calcium and magnesium from the incoming seawater while producing a fertilizer by-product, (5) a 3000-GPD horizontal spray film evaporator, (6) a falling film evaporator to determine the effects of feedwater pH and oxygen content on the corrosion of mild steel tubes, (7) a 15,000-GPD plant and a 200,000-GPD plant featuring controlled crystallization in a butane freeze desalination process with direct contact heat exchange, (8) a plant based on a hydrate conversion process, (9) a vapor compression vacuum-freezing desalination process plant, and (10) a plant based on a hydrate desalination process using freon-12 as both a refrigerant and the hydrating agent.
W70-04942

THE OPTIMAL DESIGN OF MULTI-STAGE FLASH EVAPORATORS BY DYNAMIC PROGRAMMING,
Syracuse Univ., N.Y.
S. Itahara, and L. I. Stiel.
Desalination, Vol. 4, p248-57, 1968. 3 fig, 3 ref.
Identifiers: *Computerized designs, *Mathematical models, *Programs (Computers), *Systems engineering, Distillation processes, Economic evaluations, Evaporator-condenser system designs, Evaporators, Flash evaporation, Heat balance, Material balance, Multistage flash distillation.

A method employing dynamic programming is described which adjusts the brine temperature decrement of each stage in a multistage flash evaporator to achieve minimum annual operating costs. The discussion employs an elementary evaporator model for which analytical solutions are available. A flow chart of a possible computer code is given. The evaporator area cost for an infinite number of stages if formulated. Finally, a method for handling the heat reject section is shown in mathematical notation.
W70-04943

CHAMBER GEOMETRY IN MULTI-STAGE FLASH EVAPORATOR - SEPARATOR STUDIES.
Weir Westgarth Ltd., London (England).

OSW R and D Progress Report No. 271, 1967. 97 p, 23 fig, 6 tab, 14 ref.
Identifiers: *Component testing, *Design data, *Entrainment, *Flash chambers, *Flash evaporation, Experimental data, Flow control, Liquid level control, Multistage flash distillation, Open channel flow, Research results.

An earlier study of the flash chamber geometry in multistage evaporators has shown that the length of flash chambers required for a range of flashing conditions could be specified (OSW R and D 108). This report describes additional work which has been carried out to study the separator characteristics and separation geometry in a flash chamber. The first part of this report covers a study of the foam heights and entrainment heights for a range of the flashing conditions normally met with in evaporators. The second part covers a study of the pressure loss and de-entrainment characteristics of the separator mesh. This information should allow the separator height to be specified for a range of flashing conditions and indicate the maximum value of vapor loading to which the separator can be taken while still giving a reasonable vapor purity above the separator. Further information is given on the effects of brine circulation, interstate temperature difference, splash plant configuration, and brine level variations. The increase in vapor loadings which can be obtained by dosing with an antifoam solution is indicated.
W70-04944

COMPARISON OF ECONOMIC DATA OF THE MAIN TYPES OF THE DESALTING DISTILLATION PLANTS,
S. I. Golub, I. L. Sergeenko, E. A. Sobolev, V. B. Chernozubov, and V. G. Shatsillo.
Desalination Vol 5, p 29-33, 1968. 5 fig. Preprint from 2d European Symp.-Fresh Water From The Sea, Vol 4, Athens, May, 1967.
Identifiers: *Multiple effect distillation, *Multistage flash distillation, *Parametric studies, Acid stabilization processes, Construction costs, Economic evaluations, Evaporators, Feedwater treatment, Flash chambers, Flash evaporation, Flowsheets, Scale prevention, Seeding process.

A comparison of multieffect flash and multistage evaporation plants to determine which is the more economically advantageous indicated that the price of product water is approximately the same for each under the same operating conditions and with fixed heat costs. Two main flowsheets were used as the basis for comparison (1) flash evaporation with seawater recycle and scale prevention by seeding or acid treatment and (2) direct-flow evaporation with seeding. Product water price for both types of plants proved to be 7 to 12% lower with evaporation chambers of concrete than with metal, and scale prevention by seeding proved less expensive than that by acid treatment of feedwater. Flash evaporation plants are preferable economically in case of high heat costs, whereas the multistage evaporation plant is economically advantageous when heat costs are relatively low.
W70-04947

THE EILAT 1,000,000 GPD, MSF, DISTILLATION PLANT OPERATING EXPERIENCE,
N. Zuckerman.
Preprint from 2d European Symp.-Fresh Water From The Sea, Vol 2, Athens, May, 1967. 28 p, 9 fig, 8 ref.
Identifiers: *Flash evaporation, *Multistage flash distillation, *Operating experience, Corrosion, Corrosion control, Corrosion problems, Distillation processes, Fouling, Israel, pH control, Scale prevention, 0-5C MGD Plant.

A brief history of the Eilat Plant, which began operation in 1965 and is presently delivering about 1 MGD of fresh water continuously at 1-3 PPM TOS. The evaporator is MSF recirculating cross-tube type designed for 200 deg F top brine temperature, performance ratio 8 to 1, concentration factor 1.7, with scale prevention originally by Hagevap LP treatment but later converted to PH control. The influence of controlled parameters

and of additives on fouling, foaming, corrosion, performance ratio and distillate output is described, analyzed and discussed. Actual performance is compared to results of a mathematical model programmed for a digital computer. High temperature tests are described, and the importance of matching conditions to chamber geometry is discussed.
W70-04948

CORROSION OF MILD STEEL UNDER OPERATING CONDITIONS OF A DISTILLATION DESALTING PLANT.
For primary bibliographic entry see Field 08G.
W70-04949

DESIGN, OPERATION, AND RESULTS OF THE LARGEST FLASH-TYPE SEAWATER CONVERSION PLANT AND ITS EFFECT ON FUTURE CONVERSION PLANTS.
Westinghouse Electric Corp., Philadelphia, Pa.

Proc. Am. Power Conf, Vol 24, p 751-59, 1962. 6 fig.
Identifiers: *Dual-purpose plant, *Flash evaporation, *Reviews, Point Loma Plant, Water costs estimate, Water utilization.

Current U.S. water usage is running at the rate of about 323 BGD. By 1975 it will be 453 BGD, and by 1980 it will be 597 BGD, which is 82 BGD more than the estimated supply. Desalination of sea and brackish water can meet this shortage. To date about 50 land-based flash evaporators have been purchased throughout the world, including a 1 MGD unit at Point Loma, Calif. Design work and data taken since the inception of this plant show that flash distillation on a larger scale can produce water at a cost low enough to compete with conventional supplies in many areas. Further economies can be obtained with dual-purpose plants so that water can be produced for 41 cents/1000 gal. The design and construction of dual-purpose plants will meet the water needs, base-load power systems, develop the service areas, and may result in new low costs for power generating facilities.
W70-04950

STUDY OF 250-MGD MULTISTAGE FLASH DISTILLATION PLANT WITH TWO-LEVEL BRINE FLOW - PART 1, DESIGN AND COST ESTIMATE - PART II, PRELIMINARY ENGINEERING ANALYSIS AND CAPITAL COST ESTIMATE,
Oak Ridge National Lab., Tenn.; and Bechtel Corp., San Francisco, Calif.
S. J. Senatore, and J. A. Smith.
ORNL-4214, Nov., 1968. 257 p, 56 fig, 3 ref.
Identifiers: *Conceptual designs, *Multilevel plants, *Multistage flash distillation, Concrete construction, Construction costs, Cost breakdowns, Deaerators, Flash chambers, Horizontal tube condensers, Instrumentation, Structural designs, 250 plus MGD plant.

The report presents the findings and conclusions of a conceptual design study of a 250-MGD MSF desalination plant for a hypothetical Southern California location in 1975-1980. The plant is coupled to a 2500-MWT boiling-water reactor through a backpressure turbine. The design uses a two-level brine recycle system with fifty stages, a flashing brine temperature range of 250 deg F to 91.8 deg F and a product water temperature of 90 deg F. The evaporator shell is steel above and steel-lined concrete below 200 deg F. The evaporator tubing is 90/10 copper-nickel with 0.035-in.-thick wall in the heat recovery section and 0.049-in.-thick wall in the heat reject section. The long-tube concept is used with two tube lengths of approximately 240 ft each in the heat recovery section. A two-stage spray deaerator and conventional sulfuric acid treatment is used for the makeup seawater. The total plant capital cost is $149,725,000 or $0.5999 per daily gallon of capacity. The water cost is $0.205/1000 gal.
W70-04951

OPERATING EXPERIENCES AT THE LTV DEMONSTRATION PLANT, FREEPORT, TEXAS,
Stearns-Roger Corp., Denver, Colo.
R. W. Akerlow.
Water Production Using Nuclear Energy, Proc. Am. Nucl. Soc. Symp., Mar., 1966, Tucson (ed. by R. G. Post, R. L. Sealf), p. 112-33, 3 fig, 10 ref, Univ. Arizona, Press, Tucson, Ariz, 1966.
Identifiers: *Freeport plant, *Operating experience, *Vertical tube evaporators, Acid stabilization processes, Component development, Deaerators, Feedwater treatment, pH adjustment, Scale prevention, Scale removal.

This plant has been in operation since 1961. Studies have led to the elimination of scaling, better utilization of heat transfer surfaces, and improvement in the distributed flow conditions in the tubes. Magnesium hydroxide seeding proved impractical to prevent scaling, but the pH method of scale control was shown to be effective. Carbon steel tubing was not practical, particularly since acid addition was needed for scale control. The steel tube was replaced with aluminum-brass. It was found that, without forming anhydrite scale, the upper limit of seawater flashing range is 27 deg F on the steam side. Polyphosphate addition was very effective as a means of scale removal. Magnesium anodes were unsuccessful in the protection of steel heat exchangers. However, an impressed current protection system appeared promising. Waste heat sources at temperature levels as low as 140 deg F can be considered practical for recovery in an LTV system. Under normal conditions, one MGD of water can be economically produced from seawater in an LTV system for each 7500 KW of generating capacity, utilizing only the waste heat from a gas turbine.
W70-04952

CONTINUOUS COUNTER-CURRENT ION EXCHANGE REMOVAL OF CALCIUM FROM SEA WATER TO PREVENT SCALING OF DISTILLATION EQUIPMENT.
Oak Ridge National Lab., Tenn.; and Chemical Separations Corp., Oak Ridge, Tenn.

OSW, R and D Progress Report No. 309, Nov., 1967. 69 p, 27 fig, 3 ref.
Identifiers: *Feedwater treatment, *Ion exchangers, *Scale prevention, Material balance, Precipitates, Removal from feedwater, Calcium, Carbonate, Scaling.

A 65% removal of calcium from seawater was demonstrated by chem-seps continuous countercurrent ion exchanger at Freeport, Texas, LTV Plant. Calcium hardness as calcium carbonate was reduced from 800 PPM to 280 PPM in the effluent from exchanger. Removal of 65% calcium prevents precipitation of anhydrites at 300 deg F. This results in heat savings of 20% and a permissible concentration factor of five rather than three. Flowsheets and theoretical material balances are included.
W70-04953

TESTS OF DEAERATOR AT THE FREEPORT SEAWATER DESALTING PLANT AND EVALUATION OF DISSOLVED GAS ANALYSIS.
Oak Ridge National Lab., Tenn.

OSW R and D Progress Report No. 310, Nov., 1967. 44 p, 11 fig, 9 ref. Also ORNL-TM-1953.
Identifiers: *Carbon dioxide analysis, *Deaerators, *Oxygen analysis, Columns (Process), Component development, Component specifications, Freeport Plant.

Tests made on the Freeport deaerator showed that oxygen could be reduced to 10 PPB and carbon dioxide to 3 PPM. Test runs were made with liquid rates of 10,600 and 17,000 LB/HR sq ft. Cambridge instrument gas analyzer was used for detection of oxygen and carbon dioxide. Further work is required to check the validity of the calibrator before reading can be considered reliable.
W70-04954

OPTIMUM BRINE HEATER OUTLET TEMPERATURE IN SEA WATER CONVERSION EVAPORATORS.
Bechtel Corp., San Francisco, Calif.

OSW R and D Progress Report No. 175, Apr., 1966. 160 p, 34 fig, 17 ref.
Identifiers: *Brine heaters, *Feedwater heating, Brine system designs, Computerized designs, Cost breakdowns, Economic evaluations, Energy costs, Evaporator system design, Flash evaporation, Ground rules, Multistage flash distillation, Parametric studies, Plant layout, Water costs estimate.

Large size nuclear power and water desalting plants may answer the future needs of an expanding civilization for power and water, but the more immediate problem of providing incremental water supplies up to 50 MGD where no power is needed is unanswered. A single-purpose fossil-fueled desalination plant with a capacity from 8 to 50 MGD has been developed. A modification of this plant with acid pretreatment and operating at 290 deg F maximum brine temperature will produce 50 MGD of water at 30 cents/1000 gal with fuel at 20 cents/MBTU, or produce water at 36 cents/1000 gal with 30 cents/MBTU fuel. If scale control methods costing no more than acid pretreatment can be developed, permitting the plant to operate at its optimum temperature of 350 deg F, then water costs drop to 28.2 cents/1000 gal and 33 cents/1000 gal, respectively. Total water costs have been developed for brine heater outlet temperatures from 250 deg F to 400 deg F, for fuel costs of 20, 30 and 40 cents/MBTU. From these, costs affordable for scale prevention at the different temperatures and fuel costs have been determined. Two ORNL and one Bechtel evaporator design computer codes were modified and used for the study.
W70-04955

A STUDY OF THE MECHANISM OF FLASHING FLOW BY EXPERIMENT AND THEORETICAL ANALYSIS,
Atomic Energy Establishment, Winfrith (England).
R. I. Hawes, and D. C. Leslie.
Desalination Vol 2, p 329-36, 1967. 7 fig, 5 ref. Also preprint from 2nd European Symp.-Fresh Water From The Sea, Vol 2, Athens, May, 1967.
Identifiers: *Bubble dynamics, *Flash chambers, *Flow distribution, Flash evaporation, Fluid dynamics, Orifices, Pressure drop, Research results, Steam flow, Turbulence, Turbulent flow.

A new theory of flashing flow is described which assumes that all bubble nuclei are present when the pressure is reduced. Steam formation occurs by conduction of heat to the surfaces of these nuclei, followed by evaporation at the surface. As the bubbles grow, the two-phase mixture is accelerated in the duct, producing a pressure drop and a further increase in the superheat. An experimental study suggests that when the superheat is small, nucleation of bubbles does not occur within the bulk of the fluid and that steam formation only occurs at existing interfaces. In a desalination plant, growth of bubbles swept from one stage to the next or flashing at the free surface is likely to be most important. Measurements of the growth of steam bubbles in superheated seawater show good agreement with the theoretical predictions during the initial stages but the theory underestimates the growth rate further away from the change in pressure.
W70-04956

THE OPTIMAL DESIGN OF DESALINATION SYSTEMS.
Kansas State Univ., Manhattan.

Desalination Vol 3, p 225-36, 1967. 14 fig, 17 ref. Also preprint from 2d European Symp.-Fresh Water From The Sea, Vol 4, Athens, May, 1967.

Identifiers: *Economic evaluations, *Design, Membrane processes, *Multiple effect distillation, Multistage flash distillation, Osmosis, Water costs estimate.

Process analysis and optimization studies have been made for a multi-effect multistage flash distillation system and a multistage reverse osmosis system. In the distillation system, the heat supplied to the brine heater, the brine reject concentration, the recirculation rates within each effect, and the allocation of brine temperature and composition among the effects are controlled to arrive at an optimal policy. In the reverse osmosis process, multistage operation is compared with single-stage operation. The recirculation rates in each stage, the allocation of brine composition among the stages and the operating pressures in each stage are controlled to arrive at the optimal operating condition. A flow-work exchanger is incorporated into the reverse osmosis system and its quantitative advantages are examined under optimal conditions. A discrete form of the maximum principle in combination with other optimization techniques has been used for most of the optimization studies.
W70-04957

THE FLOW OF FLASHING WATER IN CONDUITS.
Heriot-Watt Univ., Edinburgh (Scotland); and Glasgow Univ., (Scottland).

Desalination Vol 2, p 175-95, 1967. 15 fig, 7 ref. Also preprint from 2d European Symp.-Fresh Water From The Sea, Vol. 4, Athens, May, 1967.
Identifiers: *Entrainment, *Flash evaporation, *Steam flow, *Vapor release rate, Distillation processes, Evaporators, Flow distribution, Horizontal tube evaporators, Multistage flash distillation, Turbulence promoters, Vapor compression evaporation, Vertical tube evaporators.

An analysis of flashing flow is presented in which the local rate of vapor formation is introduced, since its finite value determines the nonequilibrium character or flashing flow. A simple theoretical model is developed for calculation of the rate of vapor formation equations are set forth to describe flashing flow, and analytical solutions are presented for the simple frictionless flow case. For the more general problem including friction effects, numerical solutions are given. Experimental work on flashing flow in both horizontal and vertical tubes of 1-in. diameter show good agreement over a range of friction factors of 0.113 to 0.805 reciprocal feet. Turbulence promoters were introduced into the test sections to increase the equilibration, and their effects are reported. Experiments using two-component air-water mixtures made to check the slip between the phases and to determine the two-phase friction factors are reported.
W70-04958

PROBLEMS LIKELY TO BE ENCOUNTERED IN THE DESIGN OF LARGE FLASH DISTILLATION PLANT,
Applied Research and Engineering Ltd., Durham (England); and International Combustion Export Ltd., London (England).
R. Starmer, F. C. Thornley, and J. A. Modet.
Desalination Vol. 3, p 343-52, 1967. 8 fig, 5 ref. Also preprint from 2d European Symp.-Fresh Water From The Sea, Vol 2, Athens, May, 1967.

Descriptors: *Flash Evaporation, *Tube bundle design, *Tubing (Metal), Distillation processes, Economic evaluations, Flow measurement, Heat transfer coefficient, Heat transfer improvements, Heat transfer surfaces, 51-250 MGD Plant.

The economics and technical problems of desalination plants as large as 100 MGD are evaluated with respect to tube positions, possibilities of reducing vessel width, method of fitting total tube area, and importance of water flow problems. It is shown that for evaporator modules of over 5 MGD, tubes lying in the longitudinal axis are more compatible with requirements of tube length/stage and of shallow tube bundles. Potential cost advantages of reducing vessel width are counterbalanced by increases in brine flow rates, vessel length, tube diameter, orifice, and stage height as well as difficulties in obtaining full flashoff. It is considered that brine flow rates should not exceed 1 million LBS/HR ft width. A study of fitting the total tube area indicates that tubes of 3/4 to 1-inch diameter and of the longest possible lengths are best, but practical aspects of transport and handling must be considered. Economic advantages to be achieved in increasing module size are relatively small because tubing cost is already of such magnitude that further size increase gives little advantage. Any appreciable advantage must result from cost reductions in the evaporator shell, pumps, other auxiliaries, instrumentation, foundation, land costs and erection work.
W70-04959

3B. Water Yield Improvement

ASSESSMENT OF ATMOSPHERIC EFFECTS OF LAKE NASSER.
National Center for Atmospheric Research, Boulder, Colo.
For primary bibliographic entry see Field 02B.
W70-04756

EMPIRICAL METHOD FOR DETERMINATION OF STORAGE RESERVOIR CAPACITY,
State Inst. of Hydrology and Meteorology, Krakow (Poland).
For primary bibliographic entry see Field 04A.
W70-04759

EFFECTS OF FOREST COVER MANIPULATION ON WATER YIELD AS STUDIED BY AN ELECTRIC ANALOG,
Washington Univ., Seattle. Coll. of Forest Resources.
David D. Wooldridge.
Available from the Clearinghouse as PB-190 324, $3.00 in paper copy, $0.65 in microfiche. Completion Report, University of Washington, Seattle, January 1970. 16 p., 6 fig, 5 ref. OWRR Project A-027-WASH.

Descriptors: *Analog models, *Forest management, *Infiltration, Water yield, Watershed management, *Precipitation intensity, Hydrologic models, Rainfall-runoff relationship, Computer models.

Review of a wide variety of hydrologic modeling procedures resulting in a conclusion that the methods of Riley, et al. (1966) were most suitable for general forest hydrology needs. A function generator is used to generate any type of a precipitation event. This precipitation event becomes an input into a series of storage and flow equations. Infiltration as a flow process described by the equation of Horton (1940) is analyzed in detail for influences of various input parameters. Solution of this type of problem is a good example of the utility of electric analogy in the solution of hydrologic problems. Continuous solutions over time may be visually displayed and the influence of changing coefficients studied quantitatively after correct initial scaling. Related aspects of this research are continuing.
W70-04854

THE RANGELANDS OF THE WESTERN U.S.,
California Univ., Davis. Dept. of Agronomy.
R. Merton Love.
Scientific American, Vol 222, No 2, p 88-96, February 1970.

Descriptors: *Range management, *Brush control, *Water yield improvement, *Pasture management, Cattle, Ranges, Grasslands, Grazing, Southwest U.S., Recreation demand, Revegetation, Multiple purpose, Rocky Mountain region, Desert plants.
Identifiers: *Western U.S., *Vegetation manipulation.

Cattle grazing is the primary use of the rangeland in the western United States. The western ranges fall into three distinct categories: Northern Rocky Mountain, Intermountain, and Southwest. True grassland is rare in the Southwest. Instead, desert and semi-deserts predominate. Vegetation management is the major problem in improving the ranges lands. Brush conversion programs have shown substantial increases in water yield in the treated areas. This is due to the fact that an acre of brush uses six more acre-inches of water than does herbaceous vegetation. (Carr-Arizona)
W70-04907

THE WATER SITUATION,
Arizona State Water Engineer; and Arizona Interstate Stream Commission.
Wesley E. Steiner.
In Arizona Watershed Symposium, 13th, Phoenix, Arizona, September 24, 1969, Proceedings, p 11-14.

Descriptors: *Arizona, *Planning, *Water supply, *Water resources, *Water allocation (Policy), Arid lands, Groundwater, Overdraft, Urbanization, Population, Growth rates, Land use, Irrigation, Water resources development, Subsidence, Decision making, Optimum development plans, Water demand, Water yield improvement.
Identifiers: *C.A.P. (Central Arizona Project), *Arizona Interstate Stream Commission.

Arizona, an arid state, is experiencing an enormous rate of growth. Without an adequate water supply this growth will be severely limited. Even though urban land uses are expected to take over much of the presently irrigated agricultural acreage, current federal and state studies project an increase in total irrigated acreage in the future. The central Arizona area already has a groundwater overdraft of 2.2 MAF per year. Operation of the Central Arizona Project will still leave central Arizona with a 1 MAF annual overdraft. Although CAP will not totally relieve Arizona's water problems, it will buy time for the state until other plans can be developed. Planning for future projects should begin immediately. (Carr-Arizona)
W70-04914

FOG IN ISRAEL,
Israel Meteorological Service, Bet Dagan. Div. of Synoptic Meteorology.
M. Levi.
Israel Journal of Earth-Sciences, Vol 16, No 1, p 7-21, 1967. 10 fig, 2 tab, 6 ref.

Descriptors: *Fog, *Moisture, *Semi-arid climates, *Winds, Anticyclones, Transportation, Agriculture, Meteorology, Fronts (Atmospheric), Air circulation, Water vapor, Atmospheric pressure, Synoptic analysis, Radiation.
Identifiers: *Radiation fog, *Israel, Inversions, Sudan Trough, Khamsin depression.

Generally only radiational fog occurs in Israel. True advection fog is very rare. Typical fog-inducing meteorological situations include a warm upper anticyclone, a shallow surface pressure ridge in the wake of a cold front, influence of the Sudan Trough, an approaching Khamsin depression, and the passing of a weak, dissolving cold front. Fog occurs infrequently on the Israeli coastal plain, but is more common in the northern valleys of Israel and in parts of the Northern Negev. Fog is not a major problem in Israel, but it does occasionally tie up the transportation process. Fog is also important in the semi-arid Israeli climate as a source of additional moisture supply for agriculture. (Carr-Arizona)
W70-04915

MANIPULATING VEGETATION FOR WATER CONSERVATION,
Salt River Valley Water Users' Association, Phoenix, Ariz.

William L. Warskow, Robert E. Moore, and David S. Wilson, Jr.
Agricultural Engineering, Vol 50, No 1, p 24-25, January 1969. 2 tab.

Descriptors: *Range management, *Runoff, *Water conservation, *Water yield improvement, *Brush control, Juniper trees, Chaparral, Forest management, Lumbering, Clear-cutting, Arizona, Arid lands, Grasses.
Identifiers: *Vegetation manipulation, Salt River Valley Water Users' Association.

Vegetation manipulation is an immediate and direct method of augmenting water supplies through increasing runoff. In Arizona experiments are in progress which study the water gain from juniper eradication, chaparral conversion, and timber harvest techniques. The Salt River Valley Water Users' Association is funding these studies in conjuction with the U.S. Forest Service. (Carr-Arizona)
W70-04916

ESTHETIC INTERESTS IN WATER YIELD IMPROVEMENT,
Arizona Conservation Council.
Paul W. Van Cleve.
In Arizona Watershed Symposium, 13th, Phoenix, Arizona, September 24, 1969, Proceedings, p 25-28.

Descriptors: *Arizona, *Natural resources, *Water resources development, *Conservation, *Water yield improvement, Recreation demand, Scenery, Wildlife, Habitats, Phreatophytes, Chaparral, Brush control, Flood control, Aesthetics, Water management (Applied).
Identifiers: *Salt River Project, *Bureau of Reclamation, *U.S. Army Corps of Engineers, Wilderness.

One of Arizona's most valuable natural resources is its reputation for scenic beauty. This natural beauty is a very vulnerable resource that is presently under tremendous pressure by forces of growth. The Salt River Project opposes two proposed wilderness areas in Arizona in favor of a very high-cost, low-yield chaparral treatment program. The U.S. Army Corps of Engineers is singularly unimaginative in its Maricopa County food control project designs. The interagency phreatophyte control program also gives little consideration to recreation, scenic beauty, and wildlife habitat in streamside areas. Conservation organizations recognize the critical need for water yield improvement projects. Care must be taken in the development of such water yield and flood control programs not to sacrifice esthetic values unnecessarily. (Carr-Arizona)
W70-04917

3C. Use of Water of Impaired Quality

IRRIGATING VEGETABLES WITH BRACKISH WATER,
Agricultural Research Service, Athens, Ga. Soil and Water Conservation Research Div.; and Georgia Agricultural Experiment Station, Athens.
F. L. Long, J. M. Daniels, and J. R. Carreker.
American Society of Agricultural Engineers, Transactions, Vol 11, No 2, p 171-174, March-April 1968. 4 fig, 3 tab, 5 ref.

Descriptors: *Vegetable crops, *Irrigation water, *Brackish water, *Saline water, *Salt tolerance, Salinity, Irrigation practices, Irrigation, Georgia, Plant physiology, Leaching, Soil properties, Electrical conductance, Saturated soils, Rainfall, Crop production.
Identifiers: *Turnips, *Kale, *Collards, *Snapbeans.

Irrigation with saline water adds salts to the upper level of the soil. This may cause a salt problem in soils ordinarily considered nonsaline. In determining whether or not to use a particular brackish water supply for irrigation it must be remembered that some crops are more salt-sensitive than others. Also, plants in the seedling stage are generally more susceptible to salt damage than mature plants. A 3-year experiment studied the use of brackish vs. salt-free water in the irrigation of kale, collards, turnips, and snapbeans. The results showed that saline irrigation had no significant effect on the yield of kale, collards, and turnips, but lowered the yield of snapbeans considerably. The study also showed that rainfall was very effective in leaching the applied salts from the plots. These results have positive implications for irrigation of crops with saline water in the arid Southwest. (Carr-Arizona)
W70-04906

A STUDY OF THE EFFECT OF WATER QUALITY AND MANAGEMENT ON PHYSICAL AND CHEMICAL PROPERTIES OF SELECTED SOILS UNDER IRRIGATION,
North Dakota State Univ., Fargo. Dept. of Soils.
Fred W. Schroer.
Available from the Clearinghouse as PB-190 357, $3.00 in paper copy, $0.65 in microfiche. Technical Completion Report, North Dakota Water Resources Research Institute, February 1970. 48 p, 7 tab, 13 fig, 9 ref, append. OWRR Project A-005-NDAK.

Descriptors: *Irrigation water, Soils, *Saline soils, Saline water, *Soil physical properties, *Soil chemical properties, Carbonates, Sulfates, Loams.
Identifiers: Soil salinity.

The experiments were conducted by the North Dakota Agricultural Experiment Station in the greenhouse, and at four sites in irrigated fields. Eight by 21 inch columns of Heimdal (Typic Haploboroll) loam were seeded with alfalfa and irrigated for 20 months with 18 synthetic waters and distilled water. The waters represented groundwaters and streams of North Dakota. They ranged in salinity and sodium hazard from C2S1 to C4S4 (US Salinity Lab. Classification). Anions were HCO3 and SO4. One series had excess HCO3 over Ca plus Mg. Treatments were replicated five times. About 145 inches of water was applied in 79 irrigations to produce 24 cuttings of alfalfa. Carbonates precipitated in the lower half of columns with C2 waters. Both SO4 and CO3 salts precipitated in soils with C3 and C4 waters. ESP of soils increased with increasing SAR of the waters applied. Excess HCO3 increased soil ESP, caused ESP maxima near the soil surface, and greatly decreased infiltration rates compared to waters of similar salinity and SAR without excess HCO3 . Increasing SAR caused lower infiltration rates, but increasing salinity opposed this trend. Chemical analyses of four field irrigated soils were compared with similar data obtained prior to or near the initiation of irrigation. The Straw loam at Dickinson was near equilibrium with C2S1 water applied by gravity for 23 years, at 18 inches per year. Salinity and ESP were lower than before.
W70-04985

3D. Conservation in Domestic and Municipal Use

UTILITIES ON PERMANENT SNOWFIELDS,
Army Terrestrial Sciences Center, Hanover, N.H.
Malcolm Mellor.
Cold Regions Research and Engineering Laboratory, Science and Engineering Monograph III-A2d, October 1969. 37 p, 23 fig, 46 ref. DA Project 1T062112A130.

Descriptors: *Water supply, *Waste disposal, *Public utilities, *Cold weather construction, *Cold regions, Polar regions, Antarctic, Arctic, Sewage disposal, Melting.
Identifiers: *Snowfields, Cold region engineering.

Water supply, waste disposal, heating, ventilating and fire protection at installations built on polar ice sheets are described. The section on water supply discusses energy requirements, consumption rates, water quality and treatment, techniques and equipment for melting snow and ice, and water distribution systems. A number of actual water supply systems are described in detail. The section on waste disposal deals with sewage and sewage sinks, latrines, garbage, trash and scrap, and radioactive waste. Examples of sanitation systems at polar bases are described in some detail. The section on heating discusses heating load, heat losses and insulation, energy sources, and heating systems. The ventilation section covers air demands, intakes and exhausts, ventilation of undersnow tunnels, and carbon monoxide problems. Fire protection is discussed briefly. (Knapp-USGS)
W70-04740

3E. Conservation in Industry

PETROLEUM INDUSTRY IN ILLINOIS, 1968: PART 2. WATERFLOOD OPERATIONS,
Illinois State Geological Survey, Urbana.
For primary bibliographic entry see Field 06D.
W70-04737

3F. Conservation in Agriculture

IRRIGATION IN THE TEXAS HIGH PLAINS AND THE TEXAS WATER PLAN,
Texas Tech Univ., Lubbock.
Dan M. Wells.
Pap, Amer Soc Civ Eng Irrig Drain Div Conf, Austin, Tex, Nov, 1969. 16 p, 4 tab, 5 ref.

Descriptors: *Irrigation, *Value, *Economic impact, *Texas, Economics, Agriculture, *Economic justification, Crop production, Crops, Irrigated land, Economics, *Benefits, Agronomic crops, Farm prices, Water costs.
Identifiers: *Texas Water Plan, High Plains (USA), Ogallala formation, Agricultural economics.

Without the Texas Water Plan, or a similar plan for importing water to the High Plains of West Texas, irrigated agriculture there will start a decline that will end in oblivion in less than a century. The secondary and tertiary benefits to irrigation in the High Plains far outweigh the primary benfits. The value of irrigation in areal economy cannot be estimated on the basis of the value to farm operators alone; merchants, suppliers, processors of agricultural products, bankers, and the general population depend upon the output from irrigated agriculture to supply the capital and operating expenses for maintaining the economy. If imported water is not made available to replace the declining supplies available from the Ogallala, agriculture will not collapse, but agriculture-based businesses will feel the backlash of a decline in agricultural production. The nonagricultural segment of the High Plains should be willing to subsidize the importation of water required to sustain the present level of irrigated agriculture. Neither the State of Texas nor the Nation can afford to lose the production and consumption associated with the present and projected levels of High Plains irrigated agriculture. (USBR)
W70-04618

MECHANICAL STRUCTURES FOR FARM IRRIGATION,
Agricultural Research Service, Kimberly, Idaho. Snake River Conservation Research Center.
Alan S. Humpherys.
Proc Amer Soc Civ Eng, J Irrig Drain Div, Vol 95, No IR4, p 463-479, Dec 1969. 17 p, 17 fig, 2 tab, 3 ref, 3 append.

Descriptors: *Automation, *Irrigation systems, *Automatic control, *Control structures, *Hydraulic gates, Irrigation, Irrigation practices, Irrigation

engineering, Turnouts, Mechanization, Water control, Movable dams, Water distribution (Applied), Timing, Farm equipment, Control systems, Check structures, Check dams, Furrow irrigation.

Mechanical, automatic irrigation structures that can save water and labor are being developed for surface irrigation systems. The timer-controlled and automatic water-pressure-controlled structures are being tested in various types of irrigation systems. A specially designed mechanical timer is used to control semiautomatic irrigation checks and gates. Generalized design information is presented for a timer-controlled check dam for lined and unlined ditches. A pressure gate that opens and closes automatically when water in the channel approaches a certain depth is described. Other structures include a drop gate, metal apron gate, and water level control checks. Certain operational problems such as rodent and weed control require greater emphasis with automatic irrigation than with conventional systems. (USBR)
W70-04638

AUTOMATION OF SURFACE IRRIGATION SYSTEMS,
Agricultural Research Service, Fort Collins, Colo.
Howard R. Haise, and E. Gordon Kruse.
Proc Amer Soc Civ Eng, J Irrig Drain Div, Vol 95, No IR4, p. 503-516, Dec 1969. 14 p, 13 fig, 9 ref, append.

Descriptors: *Irrigation systems, Automatic control, Automation, Water control, Control structure, Hydraulic gates, Mechanization, Check dams, Hydraulic gates and values, Butterfly valves, Surface irrigation, Furrow irrigation, Turnouts, Control systems, Water distribution (Applied), Timing, Telemetry systems, Check structures.

Surface irrigation can be automated by using pneumatic valves controlled electronically by tone telemetry to open and close turnouts on a timed basis. However, features of cost, reliability, and safety make a hydraulically powered system appear more feasible. The hydraulic system, using cylinders to operate center pivot gates, can be adapted to a variety of open-ditch systems. Hydraulic systems can be used to open or close gates or to modulate gate openings to maintain a constant water level upstream or downstream from the gate. Two systems for automating surface irrigation are described. One system uses pneumatic valves remotely controlled by tone telemetry to open and close turnouts at timed intervals; the other uses waterpowered cylinders activated by float valves to operate center pivot gates. Large fluidic diverters have also been evaluated for irrigation applications. The automation components can be adapted to furrow, border dike, and basin-irrigated fields supplied by open ditches or buried pipelines. Several field systems have been evaluated. (USBR)
W70-04639

EFFECTS OF CONSERVATION TREATMENTS ON WATER YIELD,
Agricultural Research Service, Riesel, Texas. Southern Plains Branch; and Texas Agricultural Experiment Station, Riesel.
Ralph W. Baird, and Clarence W. Richardson.
In: Effects of Watershed Changes on Streamflow, Water Resources Symposium No 2, Austin, Texas, October 1968, p 69-78, University of Texas Press, Austin and London, 1969. 10 p, 4 fig, 3 tab, 2 ref.

Descriptors: *Agricultural watersheds, *Land management, *Watershed management, *Texas, Runoff, Sediment yield, Demonstration watersheds, Contour farming, Terracing, Vegetation establishment, Land forming, Erosion control.
Identifiers: Experimental watersheds.

The effects of land-use changes and conservation treatments on storm runoff from 4 small agricultural watersheds, ranging in size from 20 to 309 acres, are being studied at the Blacklands Experimental Watershed near Riesel, Texas. The soils of the watersheds are primarily Houston Black clay and closely related soils developed from marls of the Taylor formation. These soils are calcareous montmorillonite clays that shrink and swell with drying and wetting. Internal drainage is slow, and during prolonged periods of excess rainfall, free water may be held near the surface for appreciable periods of time. During extreme dry periods the soils shrink, and cracks several inches wide to depths of 3 feet or greater are common. Conservation practices that control the flow of water on cultivated fields and the use of agronomic practices that increase crop production with more residue to return to the soil may reduce storm runoff from small watersheds as much as 20 to 25% over a period of years. Because of the short period of record, the effects of changes from cultivated areas to permanent grasses used for grazing is not as well defined, but available data indicate that grazing of grasslands can be managed to increase storm runoff, with smaller amounts of sediment. (See W70-04723). (Knapp-USGS)
W70-04730

IRRIGATING VEGETABLES WITH BRACKISH WATER,
Agricultural Research Service, Athens, Ga. Soil and Water Conservation Research Div.; and Georgia Agricultural Experiment Station, Athens.
For primary bibliographic entry see Field 03C.
W70-04906

EFFECTS OF MODERATE SHEEP STOCKING ON PLANT POPULATIONS OF A BLACK OAK-BLUEBUSH ASSOCIATION,
Adelaide Univ. (Australia). Dept. of Botany.
Susan Barker, and R. T. Lange.
Australian Journal of Botany, Vol 17, No 3, p 527-537, December 1969. 13 fig, 4 tab, 10 ref.

Descriptors: *Stock water, *Vegetation, *Plant populations, *Stocking, Water holes, Arid lands, Ranges, Sheep, Grazing, Forage, Vegetation effects, Density, Frequency, Desert plants, Dams, Deterioration, Pasture management.
Identifiers: *Australia, *South Australia.

The investigation was concerned with description and analysis of vegetation change in arid areas subjected to many years of grazing. A hypothesis under study indicated that vegetation change would be patterned on the stocking pressure in the area. In arid lands this would imply that radial gradients would appear around water sources. Vegetation within a 2000-yd radius of a stock water dam was investigated. Stocking did not appear to have a pronounced effect on the majority of the species within the study area, however several species did demonstrate significant linear regressions between density and radial distance from the water. These observations substantiate the findings of Osborn, Wood, and Paltridge regarding stocking and vegetation gradients with respect to water. (Carr-Arizona)
W70-04911

DIURNAL VARIATION IN LEAF AND BOLL TEMPERATURES OF IRRIGATED COTTON GROWN UNDER TWO SOIL MOISTURE REGIMES IN A SEMI-ARID CLIMATE,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Irrigation Research Lab.
For primary bibliographic entry see Field 02I.
W70-04912

SIZE OF FARM IN RELATION TO IRRIGATION PUMPING COSTS,
Idaho Univ., Moscow. Dept. of Agricultural Engineering.
G. L. Corey.
American Society of Agricultural Engineers, Transactions, Vol 12, No 6, p 795-797, November-December 1969. 6 tab, 9 ref.

Descriptors: *Farms, *Pumping, *Irrigation water, *Costs, *Economics of scale, Arid lands, Idaho, Farm management, Deep-well pumping, Ground water, Irrigation efficiency, Water table, Variability, Variable costs, Rotations, Size, Drawdown, Cost-benefit analysis, Crop production, Unit costs, Computers.
Identifiers: *Farm size, Unit basis, Snake River Basin, (Ida).

Large areas of arid land in Idaho have been developed for irrigation over the past 15 years. This development generally has involved high-lift pumping. As the water table is lowered, irrigation will become more expensive due to pumping costs. The purpose of this study was to determine if farm size affected the amount of revenue a producer could pay for water on a unit basis. A synthetic firm approach was used and a definite pattern of decreasing costs with increasing farm size was established. Based on the model, a table is included giving maximum pumping lift utilizing the revenue available for water. (Carr-Arizona)
W70-04918

A MODEL FOR SIMULATING SOIL WATER REGIME IN ALTERNATING FALLOW-CROP SYSTEMS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Land Research and Regional Survey.
For primary bibliographic entry see Field 02D.
W70-04920

NET AND SOLAR RADIATION RELATIONS OVER IRRIGATED FIELD CROPS,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
For primary bibliographic entry see Field 02D.
W70-04922

CLIMATE AND ESTIMATED WATER USE BY AN ORANGE ORCHARD,
California Univ., Riverside; and Arizona Agricultural Experiment Station, Tucson.
For primary bibliographic entry see Field 02D.
W70-04923

AN INDEX OF CROP WATER STRESS RELATED TO WHEAT AND GRAIN SORGHUM YIELDS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Land Research and Regional Survey.
For primary bibliographic entry see Field 02D.
W70-04924

EVALUATION OF RESOURCE USE AND ECONOMIC EFFECTS DUE TO IRRIGATION WATER AVAILABILITY IN TEXAS,
Texas A and M Univ., College Station. Water Resources Inst.
For primary bibliographic entry see Field 06B.
W70-04983

A STUDY OF THE EFFECT OF WATER QUALITY AND MANAGEMENT ON PHYSICAL AND CHEMICAL PROPERTIES OF SELECTED SOILS UNDER IRRIGATION,
North Dakota State Univ., Fargo. Dept. of Soils.
For primary bibliographic entry see Field 03C.
W70-04985

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

TRANSFERRING STREAMFLOW CHARACTERISTICS,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02E.
W70-04554

LAGOON LEVELING TO PERMIT ANNUAL CROPPING IN SEMIARID AREAS,
Agricultural Research Service, Akron, Colo. Central Great Plains Field Station.
Rome H. Mickelson, and B. W. Greb.
Journal of Soil and Water Conservation, Vol 25, No 1, p 13-16, January-February 1970. 4 p, 3 fig, 3 tab, 6 ref.

Descriptors: *Land management, *Water conservation, *Playas, *Lake basins, *Land reclamation, *Land forming, Drainage, Watershed management, Land development, Soil management, Great Plains.
Identifiers: Lagoon leveling, Prairie potholes.

On the west-central Great Plains lie numerous irregularly shaped basins commonly referred to as lagoons, potholes, swales, or playas. These small depressions are usually 2 to 5 feet below the surrounding land and collectively comprise less than 1% of the region's total land area. They have no natural drainage outlets and intermittently become shallow ponds. Lagoon leveling converted a non- to low-productive area to a moderately productive area by providing more uniform distribution of impounded water over a larger surface area. Water supplies were adequate to permit annual cropping of forage crops in the leveled lagoon, and dry matter yields were increased 25% over those on unleveled dryland areas. A farmer can expect to recover an investment of $90 to $100 per acre in leveling costs within a period of 4 to 6 years, given normal rainfall and good management practices. (Knapp-USGS)
W70-04555

EFFECTS OF SMALL STRUCTURES ON PEAK FLOW,
Soil Conservation Service, Fort Worth, Tex. Engineering and Watershed Planning Unit.
Charlie M. Moore.
In: Effects of Watershed Changes on Streamflow, Water Resources Symposium No 2, Austin, Texas, October 1968, p 101-117, University of Texas Press, Austin and London, 1969. 17 p, 11 fig, 1 tab, 6 ref.

Descriptors: *Flood control, *Small watersheds, *Dams, Spillways, Watershed management, Rainfall-runoff relationships, Hydrograph analysis, Computer models, Peak discharge.
Identifiers: Small flood control structures.

The effects of small flood-control structures on peak flow are described. A typical floodwater-retarding structure consists of an earth dam, a drop-inlet principal spillway, and an open-channel emergency spillway. The emergency spillway consists of an inlet channel, a control section, and an exit channel. Subcritical flow exists in the inlet channel and the flow usually is supercritical in the exit channel. Dams are of small to medium size, with embankment heights ranging generally from 20 to 60 feet. A few approach or exceed 100 feet. Their drainage areas range from less than 1 sq mi to more than 50 sq mi, but most measure from 1 to 20 sq mi. Their storage capacity may be as much as 12,500 acre-ft for floodwater detention and 25,000 acre-ft total for combined uses. The capacities of most of the structures built to date range generally from 500 to 2,000 acre-ft. A study was made on Escondido Creek, near Kenedy, Texas, where 50% of the upstream structures had been completed on the 74,880-acre project. The Escondido Report includes a detailed analysis of the August 28-29, 1946, storm. It was determined that the natural peak discharge of 22,700 cfs was reduced by the effect of SCS flood-detention reservoirs to 14,600 cfs. (See W70-04723). (Knapp-USGS)
W70-04571

MECHANICAL STRUCTURES FOR FARM IRRIGATION,
Agricultural Research Service, Kimberly, Idaho. Snake River Conservation Research Center.
For primary bibliographic entry see Field 03F.
W70-04638

AUTOMATION OF SURFACE IRRIGATION SYSTEMS,
Agricultural Research Service, Fort Collins, Colo.
For primary bibliographic entry see Field 03F.
W70-04639

FLOOD PLAIN INFORMATION, KIHEI, MAUI, HAWAII.
Corps of Engineers, Honolulu, Hawaii.

Corps Engineers Flood Plain Report, January 1970. 19 p, 11 fig, 7 plate.

Descriptors: *Floods, *Flood damage, Flood plains, Flood control, Non-structural alternatives, *Hawaii, Maximum probable flood, Tsunamis, Tides, Storms, Waves (Water).
Identifiers: Kihei (Hawaii), Maui (Hawaii), Standard project flood, Intermediate regional flood.

Flooding in Kihei, Maui, Hawaii is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-04713

EFFECTS OF CONSERVATION TREATMENTS ON WATER YIELD,
Agricultural Research Service, Riesel, Texas. Southern Plains Branch; and Texas Agricultural Experiment Station, Riesel.
For primary bibliographic entry see Field 03F.
W70-04730

FLOOD PLAIN INFORMATION, HORSE CREEK, AIKEN COUNTY, SOUTH CAROLINA.
Corps of Engineers, Savannah, Ga.

Corps Engineers Flood Plain Report, June 1969. 34 p, 8 fig, 18 plate, 11 tab.

Descriptors: *Floods, *Flood damage, *South Carolina, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: Aiken County (S.C.), Standard project flood, Intermediate regional flood.

Flooding of Horse Creek, Aiken County, South Carolina is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-04738

STORAGE REQUIRED FOR DIFFERENT TYPES OF STREAM FLOW REGULATION,
Mirko Melentijevich.
In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 656-667, 1966. 12 p, 8 fig, 7 ref.

Descriptors: *Water storage, *Reservoir operation, *Regulation, *Reservoir design, *Streamflow forecasting, Probability, Statistical methods, Inflow-outflow analysis, Hydrographs, Correlation analysis, Monte Carlo method, Stochastic processes, Markov processes.
Identifiers: Probability density function.

Reservoir design is discussed for situations in which the outflow is the same as the average inflow, the outflow is varied with the inflow, the outflow varies with the amount of water storage in the reservoir, and the outflow is varied both with the inflow and with amount of storage in the reservoir. The basic equations for each of these four cases are derived. Also the general equation for all four cases is given. The equations for probability density function of storage and for mean, variance, and skewness of the range of storage are given for the case when inflow minus outflow is a normal independent variable with zero mean and a variance of unity. The equations are given for the case of serial correlation between inflows. The effect of autocorrelation of streamflow is being investigated by the use of a Monte Carlo procedure, for streamflows which are first order Markov processes. (Knapp-USGS)
W70-04744

DETERMINATION OF THE REQUIRED RESERVOIR STORAGE FOR IRRIGATION UNDER THE CONDITIONS OF COMPENSATION DRAFT,
Zdenek Kos.
In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 668-682, 1966. 15 p, 6 fig, 14 ref.

Descriptors: *Water storage, *Reservoir design, *Reservoir yield, *Streamflow forecasting, *Irrigation water, Probability, Statistical methods, Economics, Optimization, Water requirements.
Identifiers: Czechoslovakia.

When regulating runoff by means of reservoirs it is often necessary to use the compensation draft. This method of regulation is often used especially for irrigation purposes. Under the conditions of a semi-humid climate, as is the case in the largest part of Czechoslovakia, it is necessary to consider irrigation only when the required drafts can be obtained at relatively low cost. A method for the determination of the degree of securing of the water-economy system function is based on Potapoff's graphical estimation of exceedance probabilities. The method has been considered for a number of different cases starting with the simple and proceeding to the more complex ones. The simplest of these cases is that of a system consisting of a single reservoir used for compensation draft for irrigation consumption which is considered centered in a single profile. The hydrologic relationship between the diversion site and that of the reservoir is taken to be so strongly affected by the effects of the intermediate watershed and by time of flow that the flows filling the reservoir and those in the diversion site can be regarded as independent. (Knapp-USGS)
W70-04745

THE OPERATION OF REGULATING RESERVOIRS,
Water Resource Board, Reading (England). Research Div.
V. K. Collinge, R. Fisher, and R. B. Bussell.
In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Associa-

tion of Scientific Hydrology, Publication No 71, p 683-695, 1966. 13 p, 6 fig, 4 ref.

Descriptors: *Reservoir operation, *Regulation, *Streamflow, Reservoirs, Reservoir storage, Reservoir yield, Streamflow forecasting, Routing, Analog models.
Identifiers: *Great Britain, Regulating reservoirs.

The development of regulating reservoirs in Britain is described, with considerations of conflicting demands on storage and the problems of operation, and with particular reference to Bala Lake, North Wales. The effect on the system of the new reservoir Llyn Celyn is discussed, and the results of different operating procedures presented. A comprehensive research program to solve the problems of river regulation is described. (Knapp-USGS)
W70-04746

STORAGE OF THE FLOODS OF SMALL WATERCOURSES, (IN FRENCH),
Transdanubian water Authority, Szekesfehervar (Hungary).
Gy. Bukovszky.
English summary included. In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 699-706, 1966. 8 p, 8 fig, 8 ref.

Descriptors: *Reservoir design, *Flood control, *Reservoir storage, *Streamflow forecasting, Water management (Applied), Model studies, Analog models, Reservoir operation, Small watersheds, Regulation.
Identifiers: *Hungary, Flood storage reservoirs.

On the basis of the meteorological conditions existing in Hungary, storage reservoirs for flood retention are classified into reservoirs for snowmelt-flood retention and reservoirs for stormwater. Solution of the storage equation is discussed. In the case of an open spillway with vertical walls there is a linear relationship between the stored volume and spillway overflow. This relationship is akin to the Muskingum equation, and to the linear relationship established for characteristic riverbed stretches by Kalinin, but whereas the Muskingum coefficient of proportionality depends on the hydrograph, the Kalinin coefficient is determined in advance by the physical characteristics of the storage reservoir and the spillway. The linear relationship permits the use of electric analogs and in the case of a closed spillway the relationship can be linearized. (Knapp-USGS)
W70-04747

QUEUING THEORY AND MULTIPLE-PURPOSE RESERVOIR DESIGN,
Institut fuer Wasserwirtschaft, Berlin (East Germany).
S. Dyck, and M. Schramm.
In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 707-710, 1966. 4 p, 1 ref.

Descriptors: *Reservoir design, *Streamflow forecasting, *Statistical methods, *Probability, Water storage, Runoff forecasting, Mass curves, Queuing theory, Linear programming, Hydrologic data, Depth-area-duration analysis, Rainfall-runoff relationships.
Identifiers: *Germany.

Seasonal changes of streamflow and sequential correlations between months are considered by duration curves of monthly flows. Considering the release rule and the storage capacity, 12 separate sets of queuing equations are set up to be solved as a simultaneous system of equations. In this system the available flood control storage may change from month to month. The solution of the 12 sets of equations produces the frequency distribution of storage, the probability of spilling, and the probability of being empty for each month of the year. The total probability of guarantee of the reservoir yield follows from the probability of the 12 months, considering the rules of the probability theory. The probability routing and the simultaneous solution of all 12 months are solved by an electronic computer. (Knapp-USGS)
W70-04748

CERTAINTY OF STREAM-FLOW CONTROL WITHIN A LIMITED PERIOD OF TIME,
Toronto Univ., (Ontario). Dept. of Mechanical Engineering.
Vit Klemes.
In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 711-719, 1966. 9 p, 3 fig, 19 ref.

Descriptors: *Reservoir operation, *Water management (Applied), *Streamflow forecasting, *Cost-benefit analysis, *Probability, Statistical methods, Optimization, Regulation, Flood control, Reservoir design, Synthetic hydrology, Model studies, Mathematical models.
Identifiers: *Czechoslovakia.

Present methods of streamflow control calculations, both deterministic and probabilistic, determine the certainty (or the risk) of the regulated outflow from a reservoir in relation to a long, practically unlimited period of time assuming a stationary regime of regulation. As a characteristic of certainty, we obtain one numerical value which, however, does not say much about the question of prime interest, that is, about the certainty of the given draft during the period, (say, 20-30 years) since reservoir operation began. Using this long-term certainty and carrying out the cost-benefit analysis for a 100-years period, we seem to have a deep knowledge of what will happen in the far-off future. In fact, our present optimal solutions will hardly remain optimal after 20-30 years because of changes in technology, relation of prices, etc. The system which is proposed to meet its conditions of optimality after 100 years is thus not based on a realistic concept. The best methods for studying these problems are probabilistic methods of streamflow regulation, especially the methods based on simulation of synthetic flow series. However, some problems of this kind can be analyzed also by means of deterministic methods. An example shows how the certainty distribution caused by the initial filling of a reservoir can be obtained for a given chronological series, using the deterministic method. (Knapp-USGS)
W70-04749

FLOOD PREVENTION BY ENLARGEMENT OF FLOOD WAVE SUBSIDENCE,
J. W. Van der Made.
In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 720-738, 1966. 19 p, 9 fig, 2 tab, 3 ref.

Descriptors: *Flood routing, *Flood control, *Channel improvement, Flow control, Water management (Applied), Water spreading, Channel morphology, Hydraulics, Waves (Water).
Identifiers: *Flood wave subsidence.

It is a well-known phenomenon, that, when moving downstream a flood wave on a river subsides. This subsidence is a consequence of the difference between the gradient of the water level before and behind the wave crest. The gradient before the crest is steeper than behind it, so the quantity of water discharged at the front is larger than the supply at the back. Subsidence of the wave crest is the result. This subsidence is determined by the variation of the gradient in the stream direction, and by the sharpness of the peak. For a flood wave this sharpness depends on the width in which this volume is stored. If the same quantity of water is distributed over a larger width, the length of the flood wave will decrease, and the wave crest will become more peaked. As a consequence the extent of subsidence will be larger. (Knapp-USGS)
W70-04750

EMPIRICAL METHOD FOR DETERMINATION OF STORAGE RESERVOIR CAPACITY,
State Inst. of Hydrology and Meteorology, Krakow (Poland).
Wlodzimierz Meyer.
In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 651-655, 1966. 5 p, 9 ref.

Descriptors: *Reservoir operation, *Reservoir yield, *Water storage, *Reservoir storage, *Runoff forecasting, Routing, Streamflow forecasting, Inflow, Statistical methods, Hydrographs.
Identifiers: *Poland.

An empirical formula was derived for computation of the useful capacity of retention reservoirs in Poland. Mean annual discharge for long periods, discharge variability, the mean longitudinal slope of the river valley, the amount and guarantee of runoff, and an index characterizing the variability of the yearly water input to the reservoir are used as data. The formula was derived on the basis of the cases of steady or variable annual discharge from the reservoir, assuming that the reservoir is used for water power, amelioration and inland navigation. However, the index characterizing the variability of input used in the formula is of general character, and applies also to other cases of runoff variability. A nomogram for the formula makes it easier to perform the computations in practices. (Knapp-USGS)
W70-04759

GOVERNMENTAL REFILLING OF LAKES AND PONDS AND THE ARTIFICIAL MAINTENANCE OF WATER LEVELS: MUST JUST COMPENSATION BE PAID TO ABUTTING LANDOWNERS,
For primary bibliographic entry see Field 06E.
W70-04870

WATER RIGHTS IN TENNESSEE,
For primary bibliographic entry see Field 06E.
W70-04874

WATER RIGHTS IN TENNESSEE (FLOWING STREAMS),
For primary bibliographic entry see Field 06E.
W70-04875

PRESENT AND PROPOSED LEGAL CONTROL OF WATER RESOURCES IN WISCONSIN,
For primary bibliographic entry see Field 06E.
W70-04877

PRESENT AND PROPOSED LEGAL CONTROL OF WATER RESOURCES IN WISCONSIN (RIPARIAN RIGHTS AND SURFACE WATERS),
For primary bibliographic entry see Field 06E.
W70-04878

PRESENT AND PROPOSED LEGAL CONTROL OF WATER RESOURCES IN WISCONSIN (DOCTRINE OF PRIOR APPROPRIATION),
For primary bibliographic entry see Field 06E.
W70-04879

PRESENT AND PROPOSED LEGAL CONTROL OF WATER RESOURCES IN WISCONSIN (DIFFUSED SURFACE WATERS; GROUNDWATER; AND A PROPOSED WATER DIVERSION ACT),
For primary bibliographic entry see Field 06E.
W70-04880

EFFECT OF CHANNEL STRAIGHTENING ON THE MOVEMENT OF FLOOD WAVES ON BOYER RIVER,
Iowa State Water Resources Research Inst., Ames.

Surendera Kumar, and Howard P. Johnson.
Available from the Clearinghouse as PB-190 355, $3.00 in paper copy, $0.65 in microfiche. Partial Completion Report, Iowa State Water Resources Research Institute, January 15, 1970. 101 p, 5 tab, 31 fig, 33 ref, 2 append. OWRR Project No. B-005-IA.

Descriptors: Watershed hydraulics, Drainage, Iowa, *River flow, Channel flow, Channel improvement, Flood control, *Drainage effects, Controlled drainage, *Discharge (Water), Mannings equation.
Identifiers: Boyer River, *Flood waves.

Many Iowa rivers have been straightened and leveed with the objective of achieving drainage and flood control on the riparian land. Although these methods have proved beneficial to the land along the reach straightened, they have often resulted in damage to the downstream land owner's property by increasing the discharge, thus forcing the downstream owners to repair or improve their part of the channel. Litigation among drainage districts often results with downstream districts claiming partial reimbursement of the construction and maintenance costs from the districts upstream. This study was conducted to evaluate the physical effects of river straightening on the movement of flood waves with the objective of arriving at a method for the equitable apportionment of construction and maintenance costs among beneficiaries. (Author)
W70-04984

MARKOV MODELS FOR FLOW REGULATION,
Cornell Univ., Ithaca, N.Y. School of Civil Engineering.
For primary bibliographic entry see Field 06A.
W70-04987

INTEGRATING REGIONAL WATER AND POWER SYSTEMS,
Harvard Univ., Cambridge, Mass. Harvard Development Advisory Service.
For primary bibliographic entry see Field 06A.
W70-04988

A DYNAMIC MODEL OF THE ECONOMY OF THE SUSQUEHANNA RIVER BASIN,
Battelle Memorial Inst., Columbus, Ohio.
H. R. Hamilton, S. E. Goldstone, F. J. Cesario, D. C. Sweet, and D. E. Boyce.
Final Rep, Susquehanna River Basin Group, August 1966. 25 p, 14 fig, 11 tab, 12 append.

Descriptors: *Mathematical models, *Economics, *River basins, *Water utilization, *Water resources development, Investment, Water quality, Water shortage, Population, Employment, Social aspects.
Identifiers: Susquehanna River.

The report summarized a three-phase research program during which a dynamic mathematical model of the economy of the Susquehanna River Basin was developed. The model integrated population, employment, and water resource variables that had been treated independently previously and was capable of generating economic and water-use projection for the Basin under a wide variety of alternative assumptions. Major conclusions of the study were (a) the water resource of the Basin appeared adequate to support economic growth for the foreseeable future without the construction of major systems of river works, (b) water quality in the Basin was generally good, (c) investment in water treatment and distribution systems than by a shortage of water resources, and (d) the usefulness of a computer simulation for regional economic and regional resource studies was demonstrated. (Thiuri-Cornell)
W70-04992

METHODS FOR FORECASTING OF WATER INFLOW TO RIVERS AND RESERVOIRS,
Hydrometeorological Centre, Moscow (USSR).
E. S. Zmieva.
In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 641-650, 1966. 10 p, 5 fig, 17 ref.

Descriptors: *Streamflow forecasting, *Water management (Applied), Runoff forecasting, Routing, Reservoir design, Regulation, Water balance, Hydrologic budget, Flood routing, Model studies, Water storage, Reservior yield, Safe yield.
Identifiers: *USSR.

The methods for forecasting water inflow to reservoirs in the USSR are considered using the Volgo-Kama hydro-electric power stations as an example. The methods for forecasting are based on water balance of catchment areas. A series of correlative relationships is presented in the form of diagrams or empirical formulas. Equations of water balance of the reservoirs and section of the river between the two hydrometric gages as well as the data of river runoff, feeding a reservoir or a river section, are used to calculate water inflow. Flood wave transformation is taken into account be means of lag-time curves. Calculations are carried out on an analog computer or electronic computers. (Knapp-USGS)
W70-05019

GENERALIZED EVALUATIONS OF THE PROBABILITY OF RESERVOIR EMPTINESS WITH GAUSSIAN OR GAMMA INPUTS FOR THE TWO-SEASON CASE,
Water Research Association, Medmenham (England).
Jennifer Jones, and J. A. Cole.
In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 611-618, 1966. 8 p, 6 fig, 2 ref.

Descriptors: *Reservoir yield, *Reservoir storage, *Statistical methods, Draft-storage curves, Probability, Water-level fluctuations, Safe yield, Reservoir yield, Reservoir operation, Water management (Applied).
Identifiers: Reservoir depletion probability.

The long-term probability of emptiness of a reservoir is calculated for various possible inputs. The input frequencies are given by four parameters that define Gaussian or gamma functions for the gain and depletion seasons. By expressing the reservoir volume in ratio to the average annual gain, the computed results may be expressed in dimensionless fashion. (Knapp-USGS)
W70-05020

BANK FORMATION OF NEWLY ESTABLISHED RESERVOIRS,
State Hydrological Inst. (USSR).
N. E. Kondratjev.
French resume included. In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 804-811, 1966. 8 p, 4 fig.

Descriptors: *Bank erosion, *Reservoirs, *Waves (Water), Sedimentation, Sediment transport, Currents (Water), Water levels, Winds, Erosion.
Identifiers: Reservoir bank erosion.

Methods are given for calculating bank erosion and final stable bank form in new reservoirs. The effects of longshore currents on sediment transport and the shape of banks and depositional terraces are included. Wave erosion is estimated by theoretical calculation or wind and wave energy relations. (Knapp-USGS)
W70-05022

BEHAVIOR OF CHANNELS UPSTREAM FROM RESERVOIRS,
Geological Survey, Tucson, Ariz.
For primary bibliographic entry see Field 02E.
W70-05023

SOME VARIABLES WHICH INFLUENCE RATES OF RESERVOIR SEDIMENTATION IN WESTERN UNITED STATES,
Soil Conservation Service, Portland, Oreg. Engineering and Watershed Planning Unit.
For primary bibliographic entry see Field 02J.
W70-05024

SEDIMENT DESIGN REQUIREMENT FOR SMALL RESERVOIRS,
Soil Conservation Service, Washington, D.C. Engineering Div.
For primary bibliographic entry see Field 02J.
W70-05025

THE IJSSEL LAKE AS A MULTI-PURPOSE RESERVOIR,
Zuider Zee Works (Netherlands). Hydrology Section.
For primary bibliographic entry see Field 08A.
W70-05027

ON THE SAFETY GIVEN BY A SEASONAL REGULATION RESERVOIR. (IN FRENCH),
Electricite de France, Chatou. Centre de Recherches et d'Essais.
J. Bernier.
In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 575-589, 1966. 15 p, 3 fig, 7 ref, append.

Descriptors: *Reservoir operation, *Water management (Applied), *Water storage, *Safe yield, *Statistical methods, Markov processes, Reservoir yield, Runoff forecasting, Regulation, Multiple-purpose reservoirs, Probability.
Identifiers: Reservoir operation policy.

Various methods for determination of the safe yield of a storage reservoir are discussed. It appears that all the usual methods are based upon different definitions of the safety and therefore solve different problems. The definition of safe yield based upon the probability of failure is discussed and methods based upon the theory of Markov processes are presented. The safe yield of a reservoir clearly depends on the operation policy, particularly in the case of multipurpose reservoir. (Knapp-USGS)
W70-05028

APPLICATIONS OF TWO-SEASON STATISTICS TO RESERVOIR YIELD CALCULATION,
Water Research Association, Medmenham (England).
J. A. Cole.
French summary included. In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 590-597, 1966. 8 p, 3 fig, 4 tab, 13 ref.

Descriptors: *Reservoir yield, *Statistical methods, Reservoir operation, Water management (Applied), Probability, Safe yield, Runoff forecasting, Regulation, Computers.
Identifiers: Net additions to storage.

Moran's transition matrix theory is applied to a water reservoir by considering seasons of irregular length with alternating gain and loss of contents. The method is illustrated for the case of an off-channel reservoir replenished from a river, using pumps of limited capacity, but is shown to be more generally applicable. Using Lloyd's bivariate matrix procedure, the importance of serial correlation of seasonal inflows is assessed, and an empirical adjustment of the probability of emptiness is established. (Knapp-USGS)
W70-05029

DISPOSABLE VOLUMES AND FLOW CONTROL IN HYDROELECTRIC RESERVOIRS. (IN FRENCH),
Electricite de France, Grenoble. General Technical Div.
M. M. Lugiez, and Andre Douillet.
In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 598-610, 1966. 13 p, 3 fig, 2 tab.

Descriptors: *Reservoir yield, *Reservoir operation, *Draft-storage curves, Electric power, Water levels, Water storage, Statistical methods, Stage-discharge relations, Reservoir storage, Water management (Applied).
Identifiers: France, Reservoir capacity.

Control of water in hydroelectric reservoirs requires an accurate knowledge of the relation between storage and water level. Determination of this relation is actually done by Electricite de France from stereophotographs taken from an aircraft, combined with the use of an electronic computer which determines the elementary surfaces and then the volumes. Measurements made with manometers need important corrections to take into account variations of atmospheric pressure, density and compressibility of water. In some places, the disposable volume in a reservoir can change considerably in time because of silting. When the reservoir cannot be drained off entirely, bottom topography is determined by means of 'ultrasonics' emitted from a boat. When the reservoir can be entirely drained off, volumes of sediment are determined by means of periodical stereophotographs from an aircraft. Stream-gaging by dilution methods is very useful. Study of floods is facilitated by use of information from a system of automatic measurement stations located within the drainage basin above the reservoirs. (Knapp-USGS)
W70-05030

PROBABILISTIC RESERVOIR DESIGN,
Lancaster Univ., Bailrigg (England). Dept. of Mathematics.
E. H. Lloyd.
French resume included. In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 619-625, 1966. 7 p, 19 ref.

Descriptors: *Water management (Applied), *Reservoir design, *Simulation analysis, *Probability, Markov processes, Stochastic processes, Statistical methods, Streamflow forecasting, Reservoir yield, Safe yield.
Identifiers: Autocorrelation.

Methods of calculating probabilities of reservoir contents by statistical methods are reviewed. The models describing reservoir filling are stochastic, autocorrelative, and seasonal. Systems involving several streams and reservoirs, in which flood prevention, flow regulation, drought-remedial water storage, power generation, recreation, and other uses are planned, can at present be dealt with only by simulation. The method discussed analyzes single-purpose single reservoir systems by probability theory and suggests methods of extension by models. (Knapp-USGS)
W70-05031

APPLICATION OF A METHOD BASED ON THE CALCULUS OF PROBABILITY IN THE ELABORATION OF HYDROLOGIC DATA,
Ente Nazionale per l'Energia Elettrica, Venice (Italy).
Giorgio Conci.
French resume included. In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 626-632, 1966. 7 p.

Descriptors: *Water management (Applied), *Reservoir design, *Streamflow forecasting, *Statistical methods, Probability, Reservoir yield, Safe yield, Hydrologic data, Stochastic processes, Optimization.
Identifiers: Reservoir yield forecasting.

To determine the exact capacity of a hydro-electric reservoir it is necessary to know both the precise water availability at chosen degrees of industrial risk, and their exact annual distribution. The presence of an anomalous year can alter the exact determination of hydraulically available resources, and the common application of the distribution of the standard year cannot be considered thoroughly reliable as it may often been based on an entirely coincidental occurrence. Correct determination of water availability is discussed. Such results are easily obtainable by applying a method based on the calculus of probability to obtain an expression for planning the most economical oversize to be assigned to the reservoir in order to safely allow variations of distribution. (Knapp-USGS)
W70-05032

DETERMINATION OF THE ECONOMIC CAPACITY OF STORAGE RESERVOIRS,
Reditelstvi Vodnich Toku, Prague (Czechoslovakia).
Vladmir Soucek.
In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 633-640, 1966. 8 p, 2 fig, 4 tab, 12 ref.

Descriptors: *Water resources development, *Planning, *Water management (Applied), Probability, Statistical methods, Stochastic proscesses, Meteorology, Climatology, Runoff forecasting.
Identifiers: *Czechoslovakia.

The economics of integrated use of surface water resources and the implementation of the Czechoslovakian State Hydrological Plan are discussed. Probability studies are used to predict reservoir contents and to plan dam construction. The autocorrelation coefficient of annual flows is used as a tool for improving economic design and for using water storage systems more efficiently. (Knapp-USGS)
W70-05033

USING MAPS TO ESTIMATE THE TOTAL WATER STORAGE OF LITTLE RESERVOIRS OF A REGION. (IN FRENCH),
Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France).
For primary bibliographic entry see Field 02E.
W70-05034

4B. Groundwater Management

CHANGES IN CHEMICAL QUALITY OF GROUNDWATER IN THREE AREAS IN THE GREAT BASIN, UTAH,
Geological Survey, Salt Lake City, Utah.
For primary bibliographic entry see Field 02K.
W70-04579

REGIONAL INTEGRATION OF SURFACE AND GROUNDWATER RESOURCES,
California State Dept. of Water Resources, Los Angeles.
Thelma A. Johnson, and Helen J. Peters.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 493-499, 1967. 7 p, 1 fig.

Descriptors: *Conjunctive use, *California, *Water resources development, Water management (Applied), Optimum development plans, Economics, Planning, Water storage, Water rights.
Identifiers: *California Water Plan.

California's surface and groundwater resources have been developed separately with a minimum of conjunctive operation. Groundwater development has been local, while surface water development and transportation has extended to large developments with major transportation systems. The California Water Plan outlines far-future development of surface and groundwater resources, but the Plan does not provide a staged development. Current continuing staging studies are designed to produce and continually refine a time-related economic plan to meet California's water needs. Full integration of the groundwater and surface water resources of yield, storage capacity, water-in-storage and transmission capacity are necessary for proper project staging. The planned integration must be staged with a proper framework of economic criteria. Economic criteria and possible alternative physical possibilities are explored. Some project purposes, benefit measurement techniques, and economic demand techniques are identified. Successive approximation steps in applying the economic criteria are outlined. Questions of conflict between economic benefits and costs at the local and at the regional level and administrative considerations are explored. (Knapp-USGS)
W70-04604

INVESTIGATIONS ON WATER QUALITY AT ARTIFICIAL RECHARGE OF GROUNDWATER,
Public Health and Epidemiology Station, Miskolc (Hungary); and Public Health Inst., Budapest (Hungary).
A. Fazold, Zs. Biro, S. Takacs, and K. Schiefner.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 271-277, 1967. 7 p, 4 fig, 1 tab, 2 ref.

Descriptors: *Water storage, *Artificial recharge, *Pit recharge, Water spreading, Water treatment, Flooding, Unsteady flow, River flow, Observation wells, Water quality, Water levels, Dissolved oxygen.
Identifiers: *Hungary.

Five years of research on the chemical, biological and bacteriological changes at artificial recharge of groundwater showed that the periodical operation of a new recharge basin has a harmful effect on the water quality in a coarse sandy-pebble aquifer, and the minimal distance between the wells and recharge basins should be 50 meters. In the case of a short retention of recharge water in the ground, the free carbonic acid, the total hardness, the iron and manganese decrease, and the quantity of the dissolved oxygen and the pH-value increase. In a long retention the free carbonic acid and iron content will rise, the quantity of dissolved oxygen will not vary, and the value of pH will decrease. (Knapp-USGS)
W70-04605

FIELD MEASUREMENT OF SATURATED HYDRAULIC CONDUCTIVITY IN INITIALLY UNSATURATED SOIL,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
For primary bibliographic entry see Field 02G.
W70-04607

ARTIFICIAL FORMATION OF FRESH GROUNDWATER LENSES BY MEANS OF WELLS,
All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
I. S. Glazunov.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 237-242, 1967. 6 p, 2 fig.

Descriptors: *Artificial recharge, *Recharge wells, *Saline water-freshwater interfaces, Water storage, Aquifers, Groundwater movement, Water yield, Saline water intrusion.

Identifiers: Fresh water lenses.

The problems of artificial formation of new fresh groundwater lenses as well as replenishment of existing ones by means of a system of fully penetrating recharge and pumped wells are discussed. The technique allows formation of the lateral boundary of a lens to be calculated. The calculation relationships have been obtained for constant and exponentially changing flows of recharge wells. Piston-like displacement of saline water by fresh water is assumed. Solutions are given for 3 recharge wells at the corners of an equilateral triangle, 3 recharge wells in the corners of an equilateral triangle with a pumped well in the center, 4 recharge wells in a quadrangle, and 4 wells in a quadrangle with a pumped well in the center. (Knapp-USGS)
W70-04608

CLARIFICATION OF TURBID WATER WITH POLYELECTROLYTES FOR RECHARGE THROUGH WELLS,
Technion-Israel Inst. of Tech., Haifa. Sanitary Engineering Lab.; and Agricultural Research Service, Bushland, Tex. Southern Plains Branch.
M. Rebhun, and V. L. Hauser.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 218-228, 1967. 11 p, 9 fig, 8 ref.

Descriptors: *Artificial recharge, *Water treatment, *Coagulation, Electrolytes, Clays, Turbidity, Injection wells, Permeability, Filtration, Texas, Playas, Water spreading.
Identifiers: Polyelectrolyte coagulation.

Storm runoff water is a good source of additional water supply for arid and semiarid regions; however, it must be stored for later use. Storage of these waters in aquifers by artificial recharge is hindered by suspended solids in the water. For recharge by injection through wells, removal of suspended solids must be nearly complete. Polyelectrolyte flocculants effectively clarify suspensions typical of flood runoff water. A simple field system was built and tested, and all elements of a complete system including treatment with polyelectrolytes, a simple clarification system, and groundwater recharge through wells were combined into a successful operating unit. (Knapp-USGS)
W70-04609

A FRESH-WATER CANAL AS A BARRIER TO SALT-WATER INTRUSION,
Alberta Univ., Edmonton; and Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
Srisakdi Charmonman, M. R. Carstens, and George D. May.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 374-382, 1967. 9 p, 4 fig, 2 tab, 6 ref. OWRR Project B-003-GA.

Descriptors: *Artificial recharge, *Saline water intrusion, *Groundwater barriers, *Canal seepage, Groundwater movement, Saline water-freshwater interfaces, Aquifers, Coasts, Canals, Deltas.
Identifiers: Saline water barriers.

The seepage flow pattern is determined for flow from a fresh-water canal which parallels the sea. Numerical results are presented for cases in which the fresh-water seepage from the land is a small fraction of the fresh-water seepage from the canal. In other words, the fresh-water flow from the canal acts as a dam forcing the interface between the sea water and the fresh water down to a lower elevation. The solution of Laplace's equation is obtained by numerical methods for this flow situation with the boundary conditions involving a water table and a density interface. The possibility of using a fresh-water canal for agricultural reclamation of sea-water intruded deltas and marshes is discussed. (Knapp-USGS)
W70-04610

FORMATION OF FRESH GROUNDWATER LENSES AS A RESULT OF PERCOLATION FROM CANALS AND PITS,
All-Union Scientific Research Inst. of Hydrogeology and Engineering Geology, Moscow (USSR).
V. D. Grodzensky.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 360-364, 1967. 5 p, 2 fig.

Descriptors: *Saline water-freshwater interfaces, *Artificial recharge, *Irrigation water, Pit recharge, Canal seepage, Infiltration, Groundwater movement, Water quality, Water levels.
Identifiers: *USSR, Fresh-water lenses.

The formation of fresh water lenses in saline aquifers by canal or pit infiltration is analyzed. Analytical relationships are developed to show water movement, interface movement, and the effects of varying water density. The solutions obtained were verified by comparison with results of a Hele-Shaw model study. (Knapp-USGS)
W70-04611

DRAINAGE OF A SALINE-WATER AQUIFER RECHARGED BY FRESH WATER,
Windsor Univ. (Ontario). Dept. of Civil Engineering and Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
D. E. L. Maasland, and M. W. Bittinger.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 350-359, 1967. 10 p, 5 fig.

Descriptors: *Saline water intrusion, *Aquifers, *Recharge, *Hydraulic models, Model studies, Groundwater movement, Permeability, Saline water-freshwater interfaces, Drainage, Water yield, Mixing, Salinity.
Identifiers: *Hele-shaw models.

The effluent from drains in a saline water aquifer recharged with fresh water is a mixture of salt and fresh water. A Hele-Shaw model study was conducted to determine the rate of quality change of drain effluent for various conditions of drain spacing, thickness of aquifer, permeability, and recharge rate. A uniform aquifer, a layered aquifer (top layer 12 times as permeable as the bottom), and a layered aquifer (bottom layer 6 times as permeable as the top) was studied. Results are presented in the form of dimensionless charts, containing such variables as drain spacing, thickness of aquifer, permeability, recharge rate, and porosity. The charts are used to predict the salt concentration of the drain effluent at any time for various magnitudes of the variables. (Knapp-USGS)
W70-04612

SALT WATER ENCROACHMENT IN THE COASTAL PLAIN OF ISRAEL,
Ministry of Agriculture, Jerusalem (Israel). Hydrological Service.
For primary bibliographic entry see Field 02L.
W70-04613

ECONOMICS OF ARTIFICIAL RECHARGE FOR MUNICIPAL WATER SUPPLY,
Resources for the Future, Inc., Washington, D.C.
Richard J. Frankel.
Artificial Recharge and Management of Aquifers, Symposium of Haifa (March 19-26, 1967), International Association of Scientific Hydrology, Publication No 72, p 289-301, 1967. 13 p, 1 fig, 5 tab, 44 ref.

Descriptors: *Water reuse, *Artificial recharge, *Tertiary treatment, *Reclaimed water, *Economic feasibility, Cost-benefit analysis, Water demand, Water requirements, Arid lands, Humid lands.
Identifiers: Washington (D.C.).

A research project was undertaken to determine whether or not waste reclamation could be economically competitive with other water sources for municipal water supply. Numerous advanced waste treatment systems and recycle schemes were evaluated. Waste-water renovation through groundwater recharge proved to be the most feasible solution to reclamation of the effluent of any type treatment plant today. Further study has evaluated the chemical and physical limitations of artificial recharge using municipal wastes; the economic trade-offs between additional treatment prior to recharge and greater land utilization; and the break-even point for land values as a function of economics of scale. Finally the economics of a particular case-study in the arid West of the United States is discussed as well as proposed scheme for converting the nation's capital, Washington, D.C., in the humid East from using solely surface water supplies to using artificial recharge of undeveloped aquifers for future expansion of water supplies. (Knapp-USGS)
W70-04614

CHEMICAL REACTION BETWEEN RECHARGE WATER AND AQUIFER WATER,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Cincinnati Water Research Lab.; and Cincinnati Univ., Ohio. Dept. of Mathematics.
For primary bibliographic entry see Field 02K.
W70-04615

THE NEBRASKA WATER QUALITY SURVEY,
Nebraska Univ., Lincoln. Coll. of Agriculture and Home Economics.
For primary bibliographic entry see Field 02K.
W70-04616

A MATHEMATICAL MODEL OF AN EXISTING MUNICIPAL WELL FIELD,
Oklahoma State Univ., Stillwater.
For primary bibliographic entry see Field 02F.
W70-04619

ECONOMIC ASPECTS OF GROUND-WATER BASIN CONTROL,
Louisiana Water Resources Research Inst., Baton Rouge.
Laurence H. Falk.
Available from the Clearinghouse as PB-190 196, $3.00 in paper copy, $0.65 in microfiche. Louisiana Water Resources Research Institute Bull. GT-3, La. State Univ, Baton Rouge, 1970. 76 p, 9 tab, 14 fig, 79 ref, append. OWRR Projects B-001-LA, B-003-LA and B-005-LA.

Descriptors: *Marginal costs, *Capital costs, Cost comparisons, *Conjunctive use, Alternative costs, Water rights, Water management (Applied), Resource allocation, Economic efficiency, Prices, Discriminatory pricing, Water transfer, *Assessments, Tax rate, *Discount rate, Interest rate, *Cost-benefit analysis, *Benefit-cost ratio.

Existing water laws allow the misallocation of water because it is not being put to its most valued uses. Water should be subject to unconditional ownership and purchased or sold at will as long as the price reflects its marginal social cost. The present-value unit cost of replacement water produced by a private project will be less than that produced by a non-profit community project because of the corporate income tax structure, if the cost of capital is the same and the returns to outlay are constant. However, owing mainly to unequal discount rates, a community project will be more favorable, according to the benefit-cost ratio between the cost of purchasing water from the community project and the cost of the community project. Differences between the community and the national social discount rates will generally give ambiguous comparisons of economic efficiency. In Los Angeles County, water resources are misallocated because ad valorem taxes partially finance variable production costs. In additon, the prices of water imported

by the Metropolitan Water District have not reflected the marginal social costs. Efficiency could be restored by: use of pumping charges instead of ad valorem taxes; discontinuance of mandatory sales of surplus-water rights; institution of bidding for water rights; and setting of firm prices for imported water.
W70-04650

GROUNDWATER RECHARGE DESIGN FOR RENOVATING WASTE WATER,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
For primary bibliographic entry see Field 05D.
W70-04712

LAND SUBSIDENCE RELATED TO GROUNDWATER OFFTAKE IN THE NEW ORLEANS AREA,
Louisiana State Univ., Baton Rouge.
Raphael G. Kazmann, and Marla M. Heath.
In: Transactions-Gulf Coast Association of Geological Societies, Vol. XVIII, 1968, p. 108-113, 8 fig, 6 ref.

Descriptors: *Groundwater, *Artificial recharge, *Land subsidence, *Withdrawal, *Overdraft, Aquifers, Groundwater recharge, Subsidence.
Identifiers: *New Orleans.

The land surface of the New Orleans area is subsiding in a manner similar to that of other deltoric deposits in the Gulf Coast Plain. Superimposed on this broad subsidence pattern is another (more local in nature) that is associated with the lowering of the piezometric surface of the principal aquifer of the area, the '700-foot' sand. Published elevations of bench marks show an elevation decrease of as much as 1.7 feet between 1938 and 1964. The long-term implications to the city of New Orleans of the subsidence produced by groundwater offtake are significant. The land surface is already so low that additional subsidence should not be tolerated. Groundwater offtakes should not be increased; if possible, groundwater production within the area should be curtailed. If the aquifers (primarily the '700-foot' sand) are to be used in the future, they should be artificially recharged to reduce the net withdrawal of water. Four recommendations for detailed analysis of this phenomenon are forwarded: (1) present studies of local groundwater conditions should be immediately expanded and intensified; (2) the present bench mark system should be expanded; (3) the bench marks should be relevelled more frequently than in the past; and (4) the level lines should be tied and adjusted to stable inland bench marks. (Davis-Chicago)
W70-04833

THE PRESENT AND FUTURE GROUNDWATER SUPPLY OF THE BATON ROUGE AREA,
Louisiana Water Resources Research Inst., Baton Rouge.
Raphael C. Kazmann.
Available from the Clearinghouse as PB-190 358, $3.00 in paper copy, $0.65 in microfiche. Louisiana Water Resources Research Institute, Bulletin No. 5, Feb. 1970. 126p, 18 fig, 17 tab, 18 ref, 6 append. OWRR Projects A-001-LA; A-004-LA; B-001-LA thru B-005-LA.

Descriptors: *Water supply, *Groundwater, *Surface waters, Aquifers, Groundwater recharge, Saline water intrusion, Hydrogeology, *Water spreading, Water quality, Water management (Applied), *Land subsidence, *Economic efficiency, *Water costs, Marginal costs, Discount rate, *Legislation, *Water law, Reparian rights, *Water transfer, Reasonable use, Administrative agencies, River flow, Systems analysis, Pipelines, Amite River (La), Baton Rouge (La).

A principal Baton Rouge aquifer has become degraded by saline water that is drawn by heavy industrial pumping from a trapped source west of the offtake area. Because this water moves through a geological constriction, its flow is limited. Further northward movement can be halted by pumping it from waste wells. Later, injection of fresh water from a shallower aquifer, which is hydraulically connected to the Mississippi River, could form a pressure barrier against eastward flow. The maximum land subsidence resulting from continued drawdowns in the 10 presently-used aquifers may reach 5 feet. Fresh water imported from the Amite River is proposed as the future supply. This water, after its infiltration in spreading grounds, would be withdrawn through wells and then transported by pipeline to the industrial area. For peak-demand storage, part of this water could be injected into several aquifers, which would then serve as short-distance distributaries. Proposed legislation concerning water rights and administrative agencies, predicted water costs, an optimized pipeline system, and the hydrography of the Amite River are given in the appendices.
W70-04856

WATER RIGHTS IN TENNESSEE,
For primary bibliographic entry see Field 06E.
W70-04874

WATER RIGHTS IN TENNESSEE (DIFFUSED SURFACE WATERS AND UNDERGROUND WATERS),
For primary bibliographic entry see Field 06E.
W70-04876

PRESENT AND PROPOSED LEGAL CONTROL OF WATER RESOURCES IN WISCONSIN,
For primary bibliographic entry see Field 06E.
W70-04877

PRESENT AND PROPOSED LEGAL CONTROL OF WATER RESOURCES IN WISCONSIN (DIFFUSED SURFACE WATERS; GROUNDWATER; AND A PROPOSED WATER DIVERSION ACT),
For primary bibliographic entry see Field 06E.
W70-04880

GEOLOGICAL SUBSIDENCE,
For primary bibliographic entry see Field 02F.
W70-04908

4C. Effects on Water of Man's Non-Water Activities

PREDICTING THE EFFECT OF CLEAR-CUTTING ON STREAM TEMPERATURE,
Oregon State Univ., Corvallis. School of Forestry.
George W. Brown.
Journal of Soil and Water Conservation, Vol 25, No 1, p 11-13, January-February 1970. 3 p, 2 fig, 2 tab, 10 ref.

Descriptors: *Water temperature, *Clear-cutting, Forest management, Cutting management, Land clearing, Lumbering, Watershed management, Heat budget, Solar radiation, Discharge (Water), Thermal pollution, Water pollution sources.
Identifiers: Stream temperatures.

The temperature change that occurs between two points on a stream is directly proportional to the surface area of the stream and the heat load applied between these points. It is inversely proportional to the flow. Good estimates of the heat load can be made with solar radiation data if the stream is uniformly exposed to sunlight. Foresters can use this technique to predict the effect of clear-cutting on stream temperature. (Knapp-USGS)
W70-04556

SOIL EROSION IN THE DETROIT METROPOLITAN AREA,
Soil Conservation Service, East Lansing, Mich
For primary bibliographic entry see Field 02J
W70-04557

THE U. S. GEOLOGICAL SURVEY URBAN WATER PROGRAM,
Geological Survey, Washington, D.C. Water Resources Div.
William J. Schneider.
In: Effects of Watershed Changes on Streamflow, Water Resources Symposium, No 2, Austin, Texas, October 1968, p 165-168, University of Texas Press, Austin and London, 1969. 4 p.

Descriptors: *Planning, *Urbanization, *Data collections, *Water management (Applied), Research and development, Water resources development, Water supply, Waste disposal, Storm runoff.
Identifiers: U.S. Geological Survey, Urban hydrology.

The Water Resources Division of the U.S. Geological Survey is currently expanding its role in urban hydrology as rapidly as possible to meet new demands. Almost since the first stream-gaging stations were established, more than 80 years ago, water-resources data have been collected in urban areas. Today, some data are available for every one of the 222 standard metropolitan areas in the United States. In addition to the collection of basic data, the Water Resources Division has conducted studies either within or including urban areas. These have resulted in numerous reports published in the Survey publication series and in outside technical journals. In recent years, the emphasis of these studies has been on the assessment of changes in the water resources caused by urbanization. Storm drainage today is still largely designed on the basis of the empirical rational formula using rainfall intensity modified by a coefficient of runoff. The inefficiency of this method is well recognized. Greater knowledge of the part of the hydrologic cycle involving rainfall-runoff relations in urban environments is needed. A study, currently under way, will consider the data needs for urban runoff studies, appraise available and needed instrumentation for collection of these data, and advise on types of networks for collection of these data. This study is for design of pilot areas. (See W70-04723). (Knapp-USGS)
W70-04573

URBAN EFFECTS ON WATER YIELD,
Geological Survey, Menlo Park, Calif.
Arvi O. Waananen.
In: Effects of Watershed Changes on Streamflow, Water Resources Symposium No 2, Austin, Texas, October 1968, p 169-182, University of Texas Press, Austin and London, 1969. 14 p, 7 fig, 2 tab, 16 ref.

Descriptors: *Urbanization, *Rainfall-runoff relationships, *Storm runoff, *Water supply, Land use, Water yield, Hydrology, Hydrographs, Peak discharge, Hydrograph analysis, Meteorology, Sewers, Storm drains, Recharge, Sewage disposal, Waste disposal.
Identifiers: Urban hydrology, Urban meteorology.

Urban development has a significant impact on hydrologic relations. The results of various studies demonstrate the type and magnitude of many of the effects on yield. These may be summarized as including: (1) Increase in total yield from stormflow and in annual discharge: (2) decrease in base flow of those streams that remain under generally natural conditions; (3) modification of low flow of streams influenced by the importation of water, the use of which results in discharge of wastewater. This includes the increase of low flow in streams that receive septic-tank drainage, or effluents from sewage-treatment plants, or from industrial plants; (4) decrease in recharge to the underlying groundwater basins; and (5) increase in precipitation in urban areas and corresponding increase in yield.

The principal effect of urban development on yield is an increase in direct runoff. The cumulative effect of increase in stormflow from urban areas, particularly in regions of strip cities and the megalopolitan complexes developing in several areas, may be substantial on downstream receiving channels. (See W70-04723). (Knapp-USGS)
W70-04574

MODELING THE RUNOFF CHARACTERISTICS OF AN URBAN WATERSHED BY MEANS OF AN ANALOG COMPUTER,
Utah Water Research Lab., Logan.
J. Paul Riley, and V. V. Dhruva Narayana.
In: Effects of Watershed Changes on Streamflow, Water Resources Symposium No 2, Austin, Texas, October 1968, p 183-200, University of Texas Press, Austin and London, 1969. 18 p, 14 fig, 3 tab, 7 ref.

Descriptors: *Urbanization, *Rainfall-runoff relationships, *Computer models, *Analog models, Analog computers, Simulation analysis, Hydrograph analysis, Storm runoff, Peak discharge.
Identifiers: Urban hydrology, Austin (Texas).

In the synthesis of hydrograph characteristics of small urban watersheds, the distribution of the water among the various phases of the runoff process is attempted by the concept of 'equivalent rural watershed.' For a given input into both the models (Urban and its equivalent rural watershed), the outputs must be identical. The hydrograph of outflow from an urban watershed is obtained by chronologically deducting the losses due to interception, infiltration, and depression storage from precipitation on the equivalent rural watershed and then routing it through the surface and channel storages. This is being approached by computer simulation. Testing and verification of the basic mathematical model is being done by using observed rainfall and runoff data from well-instrumented runoff areas. Coefficients representing interception, depression storage, and infiltration are determined by the trial and error process on the analog computer in such a way that the outflow hydrograph predicted by the model is nearly identical to the measured prototype hydrograph. Relationships between these coefficients and various urbanization characteristics or parameters are established. Sensitivity studies which investigate the significance of each of the watershed coefficients on the outflow characteristics are also undertaken. (See W70-04723). (Knapp-USGS)
W70-04575

EFFECTS OF URBANIZATION ON PEAK FLOWS,
Michigan Univ., Ann Arbor.
E. F. Brater, and Suresh Sangal.
Research supported by FWPCA, Mich State Highway Dep and U. S. Bureau of Public Roads. In: Effects of Watershed Changes on Streamflow, Water Resources Symposium No 2, Austin, Texas, October 1968, p 201-214, University of Texas Press, Austin and London, 1969. 14 p, 8 fig, 36 ref.

Descriptors: *Urbanization, *Rainfall-runoff relationships, *Storm runoff, *Routing, Hydrograph analysis, Model studies, Mathematical models, Simulation analysis, Infiltration, Runoff, Overland flow, Peak discharge, Floods.
Identifiers: Urban hydrology.

Study of the effect of urbanization on peak flows requires the best possible knowledge of the runoff process. The volume of surface runoff is the rainfall minus infiltration and permanent retention. Some of the impermeable portions of basins result from urbanization and their magnitude must be considered in computing the infiltration capacity. Hydrologically significant impermeable area is probably smaller than the actual impermeable area, and there is evidence that it is related to population density. For basins near Detroit the significant value varies from 1% to 10%, for population densities varying from about 500 to 7,000 per square mile. Many routing techniques may provide the basis for a mathematical model of the hydraulics of storm runoff. One method of evaluating the influence of urbanization on the runoff hydrograph is to study relationships between unit hydrograph shape parameters and some measures of drainage basin characteristics. Much work has been and is being done to help find better ways of predicting peak flows from rainfall, and more emphasis is being placed on the determination of the effect of urbanization. (See W70-04723). (Knapp-USGS)
W70-04576

URBAN EFFECTS ON THE UNIT HYDROGRAPH,
Tracor, Inc., Austin, Tex.; and Texas Univ., Coll. of Engineering.
William H. Espey, Jr., David E. Winslow, and Carl W. Morgan.
In: Effects of Watershed Changes on Streamflow, Water Resources Symposium No 2, Austin, Texas, October 1968, p 215-228, University of Texas Press, Austin and London, 1969. 14 p, 10 fig, 4 tab, 15 ref. OWRR Project C-1098 (1590).

Descriptors: *Urbanization, *Storm runoff, *Hydrograph analysis, *Frequency analysis, Hydrology, Rainfall-runoff relationships, Peak discharge, Floods, Unit hydrographs.
Identifiers: Urban hydrology, Urban watersheds.

Summaries are presented of work concerning peak floods for urban areas and of a recent study concerning watersheds in Houston, Texas. Increased urbanization results in increased peak flows and accentuated high and low flows. Equations presented show that peak flows may be expected to increase from two to four times that of the flow from the undeveloped watersheds, depending upon the type of channel improvement, amount of vegetation in the channel, and the type of secondary drainage system. The capacity of the secondary drainage facilities may have a limiting effect on the peak discharge. (See W70-04723). (Knapp-USGS)
W70-04577

EXPERIENCE WITH THE EVALUATION OF URBAN EFFECTS FOR DRAINAGE DESIGN,
Turner, Collie and Braden Co., Inc., Houston, Tex.
Donald VanSickle.
In: Effects of Watershed Changes on Streamflow, Water Resources Symposium No 2, Austin, Texas, October 1968, p 229-254, University of Texas Press, Austin and London, 1969. 26 p, 17 fig, 4 tab, 17 ref.

Descriptors: *Urbanization, *Rainfall-runoff relationships, *Unit hydrographs, *Synthetic hydrology, Rational formula, Storm runoff, Peak discharge, Floods, Hydrograph analysis, Routing.
Identifiers: Houston (Tex), Urban hydrology.

An example is given of the adaptation of preliminary research data to the development of new drainage design criteria for a major metropolitan area. The new criteria should be closer to the actual needs than the old rational method criteria. The Houston metropolitan area, one of the most rapidly urbanizing areas in the United States, was used to establish and test new urban runoff criteria. In order to apply urbanization factor data to design, the following procedures are followed: (1) Develop the mean basin length and mean basin slope values from topographic maps; (2) estimate the degree of development anticipated in the watershed for the period of design; (3) estimate drainage density for each of the areas of use; (4) multiply the drainage density by the area for each type of land use to get total channel length; (5) determine the basin factor; (6) from the curves, determine the time to peak and the unit hydrograph peak for the degree of development involved; and (7) develop the unit hydrograph. A simpler way to use the criteria is to develop them as empirical curves of drainage area versus discharge, of specific use only in the urban area and for the storm frequencies for which they are designed. Synthetic unit hydrographs were prepared and tested for about 50 drainage areas in the Houston areas. (See W70-04723). (Knapp-USGS)
W70-04578

SOME ESTIMATES OF THE THERMAL EFFECTS OF A HEATED PIPELINE IN PERMAFROST,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 08A.
W70-04694

EFFECTS OF WATERSHED CHANGES ON STREAMFLOW,
Texas Univ., Austin. Dept. of Civil Engineering.
Walter L. Moore, and Carl W. Morgan.
Water Resources Symposium No 2, Austin, Texas, October 1968. Published by Univ of Texas Press, Austin and London, 1969. 289 p.

Descriptors: *Urbanization, *Rainfall-runoff relationships, *Hydrograph analysis, *Water quality, Flood control, Reservoirs, Water yield, Hydrologic budget, Planning, Water management (Applied), Hydrology, Floods, Peak discharge, Model studies, Hydraulic models, Mathematical models, Computer models, Analog models.
Identifiers: Urban hydrology.

This special lecture series was arranged to present the most advanced approaches to evaluating the effects of watershed changes on streamflow. To an increasing degree man's activities are altering the hydrologic characteristics of watersheds, both rural and urban, and it is urgent to know the character and extent of the changes and how they affect plans for development. Numerous field studies designed to evaluate the effect of specific watershed changes by comparisons between watersheds have been in operation for sufficient time to build up a significant length of record. New methods of computer simulation of watersheds have reached a stage of development to offer an attractive tool for attacking the problem in new ways. The effects of the changes can best be evaluated when the entire performance of the watershed is understood in detail. Then all of the physical processes can be followed and the performance of the watershed can be simulated by numerical or analog techniques which correspond to the physical processes. Watershed changes produce effects on both the amount and the quality of streamflow. The topics discussed include model studies, land treatment in rural watersheds, flood control structures, rural pollution, the effects of urbanization on peak flow, the effects of urbanization on water yield, and urban water quality changes. (See also W70-04724-W70-04730 and W70-04571-W70-04578). (Knapp-USGS)
W70-04723

INFORMATIONAL NEEDS ON CHANGES IN RURAL WATERSHEDS AND THEIR RELATIONSHIPS TO PLANNING ACTIVITIES,
Texas Water Development Board, Austin; and International Boundary and Water Commission, El Paso, Texas.
Lewis B. Seward, and John J. Vandertulip.
In: Effects of Watershed Changes on Streamflow, Water Resources Symposium No 2, Austin, Texas, October 1968, p 37-43, University of Texas Press, Austin and London, 1969. 7 p, 1 fig.

Descriptors: *Data collections, *Water resources development, *Texas, *Planning, Hydrologic data, Investigations, Routing, Rainfall-runoff relationships, Urbanization, Water utilization, Water requirements, Water management (Applied).
Identifiers: *Texas Water Plan, *Data requirements.

Studies for the Texas Water Plan must include computations to determine runoff accurately, under all conceivable conditions. These studies of the future water resources will, in effect, reduce known and correlated runoff records to virgin con-

ditions, to which present and future watershed conditions and developments can be applied. Present depletions by man of the various river basins of the state must be evaluated. Accurate data will be necessary on domestic and industrial water use; on use of water by cropped lands, noncropped lands consuming irrigation water incidental to irrigation, transbasin or subbasin diversions, and reservoir loss - including evaporation loss and evapotranspiration on deltas and lake shores. These computations will entail the observation of cropped and noncropped areas, and their rates of use of irrigation water. Rates of consumptive use will have to be determined through transfer of experimental consumptive-use data to various sites of use within river basins through empirical relationships between experimental and climatological data. The depletions at sites of use must be computed and then routed downstream to determine channel losses resulting from man-made depletions. Inflow-outflow hydrologic studies must be conducted to analyze reaches of streams and rivers. (See W70-04723). (Knapp-USGS)
W70-04724

APPLICATION OF CONTINUOUS ACCOUNTING TECHNIQUES TO EVALUATE THE EFFECTS OF SMALL STRUCTURES ON MUKEWATER CREEK, TEXAS,
Texas Univ., Austin, and Texas Tech Univ., Lubbock.
Erdal Coskun, B. J. Claborn, and Walter L. Moore.
In: Effects of Watershed Changes on Streamflow, Water Resources Symposium No 2, Austin, Texas, October 1968, p 79-99, University of Texas Press, Austin and London, 1969. 21 p, 11 fig, 5 tab, 9 ref.

Descriptors: *Rainfall-runoff relationships, *Small watersheds, *Computer models, *Texas, Mathematical models, Simulation analysis, Hydrologic budget, Flood control, Reservoirs, Base flow, Hydrograph analysis, Water yield, Runoff, Infiltration, Evapotranspiration.
Identifiers: Mukewater Creek (Tex), Stanford Watershed Model.

The Mukewater Creek watershed in central Texas was selected to explore the application of Stanford Watershed Model IV to evaluate the effects of changes in the watershed on its output. The general approach was to determine parameters for the watershed model to fit watershed conditions during an early period, prior to changes in the watershed, and then use the model to estimate the watershed output that would have occurred later had the watershed remained in its original condition. Comparison of these estimated flows with the measured flows at later times is probably the best available measure of the effects of changes on watershed output. The digital model has been applied to the Mukewater Creek study area using the data of the three-year period, October 1955 to September 1958, prior to the construction of the floodwater-retarding structures for selection of the program parameters. For the 13 months of available record, channel losses attributable to the structures were positive for 9 months, amounting to 506 acre-feet or 7% of the flow during those months. During the other 4 months the losses with the structures were less, amounting to a total of 404 acre-feet or 17% of the flow during those months. Based on the limited data it would appear that the additional losses due to increased evapotranspiration resulting from prolonged flow in the channels were approximately balanced by the reduced losses due to less flood-bank infiltration. (See W70-04723). (Knapp-USGS)
W70-04726

URBAN EFFECTS ON QUALITY OF STREAMFLOW,
Texas Univ., Austin. Environmental Health Engineering Research Lab.
E. Gus Fruh.
In: Effects of Watershed Changes on Streamflow, Water Resources Symposium No 2, Austin, Texas, October 1968, p 255-282, University of Texas Press, Austin and London, 1969. 28 p, 22 fig, 5 tab, 15 ref. NSF Grant GU-1963, and Texas Water Quality Bd Contract No. 68-69-281.

Descriptors: *Reservoirs, *Urbanization, *Water quality, *Stratification, *Texas, Water pollution sources, Water pollution effects, Dissolved oxygen, Aquatic bacteria, Algae.
Identifiers: Austin (Tex), Colorado River (Tex).

The effects of impoundments and urbanization on the water quality of the Colorado River of Texas were studied in the reservoirs near Austin, Texas. Lake Travis, upstream from Austin, is large and deep and has no significant input of pollution. Lake Austin, the next reservoir downstream, is much smaller and shallower, and receives some recreational and urban runoff pollution. Town Lake, in Austin, is small and narrow with predominantly river characteristics, and receives some urban runoff pollution. Oxygen concentration-water depth data for the 3 reservoirs are tabulated. In Lake Travis, even in the winter, the temperature varied with depth. During the summer, the oxygen first became depleted at the thermocline region. Throughout the fall, various depths of Lake Travis became reaerated, but oxygen-depleted waters were still passing through the penstocks in November. In winter, oxygen was present at all depths. In Lake Austin, the summer oxygen concentration in the epilimnion varied around saturation. Dissolved oxygen decreased steadily in the hypolimnion during the summer and was consistently lower above the sediments. After autumn turnover, oxygen remained uniform from top to bottom. High numbers of total and coliform bacteria were found in Lake Austin during the spring following periods of intensive rainfall. The urban stream, Barton Creek, had significantly higher concentrations of solutes, nutrients, and bacteria than Town Lake above the stream's entrance, particularly during the spring rainfall period. All of Austin's urban streams enter Town Lake and Lake Austin, with the streams from the more highly developed areas entering Town Lake. (See W70-04723). (Knapp-USGS)
W70-04727

RECOMMENDATIONS FOR WATERSHED RESEARCH PROGRAMS,
For primary bibliographic entry see Field 06B.
W70-04760

URBAN SPRAWL AND FLOODING IN SOUTHERN CALIFORNIA,
Geological Survey, Washington, D.C.
S. E. Rantz.
USGS Circular No. 601-B, Washington: 1970, 11 p, 1 fig, 1 map, 5 photo, 3 tab.

Descriptors: *Urbanization, *Flooding, *Flood control, Storm runoff, Land use, Zoning, Mudflows, Debris avalanches, Landslide.
Identifiers: *Urban sprawl.

The floods of January 1969 in south-coastal California provide a timely example of the effect of urban sprawl on flood damage. Despite record breaking, or near record breaking, stream discharges, damage was minimal in the older developed areas that are protected against inundation and debris damage by carefully planned flood-control facilities, including debris basins and flood-conveyance channels. By contrast, heavy damage occurred in areas of more recent urban sprawl where the hazards of inundation and debris or landslide damage have not been taken into consideration, and where the improvement and development of drainage or flood control facilities have not kept pace with expanding urbanization. (Davis-Chicago)
W70-04832

THE REGIONAL INTEREST IN WATERSHED MANAGEMENT,
Western States Water Council.
Jay R. Bingham.
In Arizona Watershed Symposium, 13th, Phoenix, Arizona, September 24, 1969, Proceedings, p 29-32.

Descriptors: *Water resources development, *Watershed management, *Water transfer, *Planning, *Coordination, Water law, Interstate compacts, Regional analysis, State governments, Federal government, Federal-state water rights conflicts, Public lands.
Identifiers: *Western States Water Council, Pacific Southwest Inter-Agency Committee, Pacific Northwest River Basins Commission, Public Land Law Review Commission.

The Western States Water Council was created in 1965 to effect cooperation among the western states in the development of water resources. The council has worked to establish principles, standards, and guidelines for developing regional water programs and has completed a review of large-scale water transfer proposals. The council has also brought together the heads of the Pacific Southwest Inter-Agency Committee and the Pacific Northwest River Basins Commission in an effort to coordinate the work of these two groups. The work of the Public Land Law Review Commission is of great importance to the council and it attempts to make the Commission aware of the needs of the western states. Information gained through watershed management programs is useful to all of these council activities. (Carr-Arizona)
W70-04913

4D. Watershed Protection

FIELD EXPERIMENT ON WASHITA RIVER,
Agricultural Research Service, Chickasha, Okla. Southern Plains Branch.
Monroe A. Hartman, Arlin D. Nicks, Edd D. Rhoades, Russell R. Schoof, and Paul B. Allen.
In: Effects of Watershed Changes on Streamflow, Water Resources Symposium No 2, Austin, Texas, October 1968, p 136-149, University of Texas Press, Austin and London, 1969. 14 p, 10 fig, 5 tab.

Descriptors: *Rainfall-runoff relationships, *Small watersheds, *Flood control, Dams, Reservoirs, Rain gages, Stream gages, Water yield, Runoff, Evaluation, Networks, Rainfall, Hydrograph analysis, Sediment transport, Sediment yield.
Identifiers: Southern Plains Watershed Research Center.

Initial analysis of hydrologic data from the Southern Plains Watershed Research Center, Chickasha, Oklahoma, shows that significant reductions can be expected in runoff peaks and sediment loads from watersheds treated with flood-detention dams. This has been shown with peak flow reductions of 16,400 to 8,300 cfs, 1,370 to 400 cfs, and 1,300 to 950 cfs, for three Sugar Creek storms. Sediment yield reductions with treatment were recorded on Winter Creek, where yields after treatment were only one-tenth as large as those before treatment. The effect of cover on runoff and sediment yields was measured on small watersheds. Small watersheds with poor cover had three times as much runoff and 25 times as much sediment yield as watersheds with good cover. Large flow losses from large out-of-bank flows have been recorded on the Washita River. Large flow losses have also been recorded in the physiography of a natural watershed such as Tonkawa Creek. The dense network of rain gages has shown the necessary rain-gage spacing for 95% accuracy on large and small watersheds. Data analysis currently in progress should add to the scope and reliability of the above findings. (See W70-04723). (Knapp-USGS)
W70-04572

LAND TREATMENT IN AGRICULTURAL WATERSHED HYDROLOGY RESEARCH,
Agricultural Research Service, Beltsville, Md. Soil and Water Conservation Research Div.
L. M. Glymph, and H. N. Holtan.

In: Effects of Watershed Changes on Streamflow, Water Resources Symposium No 2, Austin, Texas, October 1968, p 44-68, University of Texas Press, Austin and London, 1969. 25 p, 17 fig, 5 tab, 22 ref.

Descriptors: *Rainfall-runoff relationships, *Agricultural watersheds, *Demonstration watersheds, Mathematical models, Model studies, Management, Evapotranspiration, Watershed management, Water utilization.
Identifiers: Watershed models.

Studies of the hydrology of farm watersheds are reviewed with emphasis on relationships between land treatment and runoff coefficients. The rate of runoff depends on the size and shape of the watershed, surface slopes, nature and amount of vegetation, soil permeability, initial soil saturation, arrangements and character of drainage channels, evaporation, storage and underground conditions, and the duration and intensity of rainfall. Experimental watershed research seeks to establish principles and describe them in numerical terms so that by knowing the geology, soils, topography, and characteristics of the stream channel system of an ungaged watershed, its performance may be predicted under various land use patterns and treatments when subject to an assumed single precipitation event or to a series of such events. A mathematical model for computing the components of watershed hydrology in their natural chronological and spatial sequences of occurrence is under study by the USDA Hydrograph Laboratory. (See W70-04723). (Knapp-USGS)
W70-04725

DETERMINATION OF SILTING IN WATER BASIN BY MEANS OF SOLID TRANSPORT BALANCE, (IN FRENCH),
State Inst. of Hydrology and Meteorology, Krakow (Poland).
For primary bibliographic entry see Field 02J.
W70-04751

EVALUATION OF FACTORS AFFECTING RESERVOIR SEDIMENT DEPOSITION,
Corps of Engineers, Rock Island, Ill., Iowa Univ., Ames, and Argicultural Research Service, Columbia, Mo.
For primary bibliographic entry see Field 02J.
W70-04752

SEDIMENTATION IN A SMALL CHANNEL-TYPE RESERVOIR,
Agricultural Research Service, Columbia, Mo. Soil and Water Conservation Div., and Missouri Univ., Columbia. Dept. of Zoology.
For primary bibliographic entry see Field 02J.
W70-04753

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

USE OF TRACERS IN HARBOR, COASTAL AND OCEAN ENGINEERING,
Norges Tekniske Hoegskole, Trondheim. Dept. of Port and Ocean Engineering.
For primary bibliographic entry see Field 07B.
W70-04551

TRACE METALS IN WATERS OF THE UNITED STATES, OCTOBER 1, 1962-SEPTEMBER 30, 1967,
Federal Water Pollution Control Administration, Cincinnati, Ohio. Div. of Pollution Surveillance.
John F. Kopp, and Robert C. Kroner.
Requests for report should be sent to Dept of Interior, FWPCA, Div of Pollution Surveillance, 1014 Broadway, Cincinnati, Ohio 45202. Federal Water Pollution Control Administration, Division of Pollution Surveillance Report, 1969. 207 p, 2 fig, 12 tab, 12 ref, 16 append.

Descriptors: *Water quality, *Trace elements, *Data collections, United States, Public health, Water chemistry, Mineralogy, Hydrologic data, Water quality act, Water resources, Water supply, Surveys.
Identifiers: Trace metals.

Trace elements in waters of the United States were determined from the analysis of over 1,500 samples. The minimum, maximum and mean observed values are given along with the number of positive occurrences and the frequency of detection. These data show that boron, barium and strontium were found in solution in over 98% of all samples. Zinc, iron and copper were observed with a frequency of 74 to 76%. Manganese was observed slightly less regularly at a 51% frequency and aluminum, lead, chromium, molybdenum and nickel were detected in 16 to 33% of the samples. Cadmium, beryllium, silver, cobalt, vanadium and arsenic were detected at measurable levels in less than 7% of all samples. The total body of data approximates 30,000 determinations. Based on soluble trace metals, only 0.6% exceeded the limits set by the Water Quality Criteria for public water supplies. (Knapp-USGS)
W70-04567

CHARACTERISTICS OF WOOL DYEING WASTES AND EXPERIMENTAL TREATMENT,
For primary bibliographic entry see Field 05D.
W70-04586

OIL SAMPLING TECHNIQUES (A Progress Report).
Federal Water Pollution Control Administration, Edison, N.J. Water Quality Lab.

Available from the Clearinghouse as PB-190 171, $3.00 in paper copy, $0.65 in microfiche. Water Pollution Control Research Series DAST-12, Dec, 1969. 62 p, 19 tab, 11 fig, 8 ref. FWPCA Project 15080FHT--12/69.

Descriptors: Oil, *Sampling, Absorption, Separation, Analytical techniques.
Identifiers: *Oil sampling, Oil spillage, Oil slicks.

Sampling of oil in the environment, depending upon the thickness of the slick, can present certain operational problems, most paramount of which is the collection of an adequate volume of sample required for identification by chemical analyses. Several basic 'dip-stick' techniques, which are primarily applicable for sampling slicks with a thickness of greater than 2 mm, as well as suggested methods for sampling thin oil slicks are discussed and illustrated. Included in this report are preliminary results on oil entrapment by solid absorbents obtained by the Oil and Hazardous Materials Research Section, Edison, New Jersey. Also reported are results of investigations performed by foreign and U.S. scientists, using various types of sampling equipment and materials.
W70-04654

OIL TAGGING SYSTEM STUDY, Summary.
Melpar, Falls Church, Va.

Available from the Clearinghouse as PB-190 193, $3.00 in paper copy, $0.65 in microfiche. Federal Water Pollution Control Research Series DAST-11, Oct, 1969. 31 p, 88 ref. FWPCA Project 15080 DJQ--10/69, Contract No. 14-12-500.

Descriptors: Marking techniques, Tracing techniques, *Tagging, Oil, Oil wastes.
Identifiers: *Oil tagging, *Surveillance, Enforcement, *Oil pollution.

Several methods of identifying the source of oil pollution are critically examined. These methods are grouped into two categories: passive tagging and active tagging. Passive tagging assumes that oils are so chemically diverse that their contents consititute a stable chemical fingerprint that can be unequivocally disclosed in the laboratory. Active tagging requires that an inexpensive, coded material be added to oil; this material must be chemically and physically stable in both oil and oil slicks; it must also be readily identifiable by available analytical techniques; and it must have no adverse effect on the oil's subsequent use. Three methods of passive tagging (trace metals, sulfur-isotope ratios, and paper chromatography) and three methods of active tagging (halogenated polycyclic aromatics, organometallics, and coded microspheroids) have been examined. Passive tags cannot be recommended because the passive tags are quite likely to mingle, to evaporate, to be dissolved, or to be oxidized; even if these processes do not occur, they can create formidable forensic problems for the prosecution and telling counter-arguments for the defense. Since active tags are designed to be stable and identifiable, they are satisfactory for the job; and the three types of active tags reviewed show promise and merit.
W70-04655

OCEAN FALLOUT - THE CRATER LAKE EXPERIMENT,
New York Operations Office (AEC), N. Y. Health and Safety Lab; Lamont-Doherty Geological Observatory, Palisades, N. Y.; Woods Hole Oceanographic Institution, Mass.; and Isotopes, Inc., Westwood, N. J.
For primary bibliographic entry see Field 05B.
W70-04704

STRONTIUM-90 FALLOUT OVER LAKE MICHIGAN,
Environmental Science Services Administration, Silver Spring, Md.
For primary bibliographic entry see Field 05B.
W70-04705

LEACHING OF POLLUTANTS FROM REFUSE BEDS,
Battelle Memorial Inst., Columbus, Ohio; and West Virginia Univ., Morgantown. Dept. of Civil Engineering.
Syed R. Qasim, and Jerry C. Burchinal.
ASCE Proceedings, Journal Sanitary Engineering Division, Vol 96, No SA1, Paper 7078, p 49-58, February 1970. 10 p, 5 fig, 6 tab, 7 ref, append. USPHS Grant EF-40 (RI).

Descriptors: *Landfills, *Leaching, *Water pollution sources, *Path of pollutants, Percolation, Garbage dumps, Seepage, Public health, Water analysis, Evaporation, Evapotranspiration.
Identifiers: Sanitary landfill leaching.

A procedure is presented for estimating theoretically the chemical quality of leachates from sanitary landfills. A theory of column chromatography was employed to determine the leaching of chloride during the movement of water through refuse beds. Generalized breakthrough curves were used to obtain the theoretical chloride concentrations. Families of curves were then derived from experimental results, representing the ratios of various leaching materials to the theoretical chloride concentrations. A comparison of experimental and theoretical results shows good agreement. The method can be applied to the field study of existing landfills to determine the chemical composition of polluting liquid during the leaching process, if the cumulative precipitation, evaporation, evapotranspiration, runoff coefficients, and the depth of refuse beds are known. (Knapp-USGS)
W70-04714

TREATMENT STUDIES OF COMBINED TEXTILE AND DOMESTIC WASTES,
Purdue Univ., Lafayette, Ind.
D. T. Lauria, and C. A. Willis.

Proceedings 19th Industrial Waste Conference, p.45-58, 1964. Engineering Extension Series 117.

Descriptors: *Waste water disposal, *Pilot plant, *Sewage treatment, *Waste water treatment, *Sludge disposal, *Data collections, *Treatment facilities, Domestic waste, Effluents, Water supply, Biological treatment, Biochemical Oxygen Demand, Screening equipment, Sludge treatment, Lagoons, Aeration, Sedimentation, Chlorination, Centrifugation, Waste waters.
Identifiers: Textile waste, Grit removal, Filters (Fluid).

At Valdese, N.C., more than 80 percent of the total waste flow consists of waste waters from the dyeing and finishing operations at textile mills. The existing sewage works are overloaded and, since the effluents are discharged to a creek flowing into a lake used for recreational and water-supply purposes, it was decided to carry out pilot-plant experiments to obtain data for the design of a new plant for biological treatment of combined domestic sewage and textile waste waters. Some results of operation of the pilot plant are summarized in tables and graphs. The method of treatment chosen was a low-loading completely-mixed process, and results showed that reductions in BOD of 90 percent could be obtained with BOD loadings of at least 2 lb. of BOD per lb. of sludge per day. The oxygen requirements of the process were estimated to determine the capacity of aeration equipment required. The proposed new plant, which will have a capacity of 3.2 m.g.d., will comprise facilities for screening and grit removal, lagoons with mechanical surface aerators, sedimentation tanks, facilities for chlorination of effluents, and a sold-bowl centrifuge for thickening excess sludge before disposal as landfill. (Livengood-Mattox North Carolina State Univ)
W70-04795

CHEMICAL NATURE OF EFFLUENTS FROM THE TEXTILE, LEATHER, AND PAPER INDUSTRIES,
M. Kehren.
Ciba Review, No 1212, p 8-12, 1957.

Descriptors: *Biochemical oxidation demand, Color, Turbidity.
Identifiers: *Permanganate value, *Textile mill wastes, Dyes.

The two most common tests for all types of water are the permanganate value and biological oxygen demand. Textile effluents can contain floating matter, settleable suspended matter, colloidal impurities, polluting substances in true solution and dyes. Textile effluents show a high degree of pollution, as evidenced by their colour, turbidity, and high permanganate value. Most effluents have high dissolved or suspended mineral and organic values, and most textile wastes are alkaline. A chart on the properties of textile wastes is included. (Robinson-North Carolina State Univ)
W70-04969

5B. Sources of Pollution

BIODEGRADATION OF DODECYLGUANIDINE ACETATE (DODINE),
Geological Survey, Denver, Colo.
Marvin C. Goldberg, and Robert L. Wershaw.
Available for sale from Superintendent of Documents U S Government Printing Office, Washington, D C, 20402-Price $3.75. Geological Survey Research 1969, Professional Paper 650-D, p D235-D239, 1969. 5 p, 3 fig, 1 tab, 16 ref.

Descriptors: *Pesticides, *Biodegradation, *Fungicides, *Bottom sediments, Aquatic microorganisms, Mud, Colorado, Aquatic microbiology.
Identifiers: Dodine, Denver (Colo).

A two-part investigation of the biodegradation of dodecylguanidine acetate (dodine), a fungicide, showed that two soil organisms, a Flavobacterium sp. and an Achromobacter sp., utilize the material as the sole source of carbon. By use of C-14-labeled fungicide, the investigation also showed that the biological content of river muds typical of the Denver, Colo., area degrades up to 5% of a dodine charge within 68 days. Preconditioning the river muds to the fungicide neither enhanced or decreased the amount of biodegradation in any of the samples tested. (Knapp-USGS)
W70-04580

STATEMENT OF CONCERN,
Johns Hopkins Univ., Baltimore, Md. School of Hygiene and Public Health.
E. P. Radford, I. Merz, C. Ray, R. M. Herriott, and C. W. Kruse.
Environment, Vol 11, No 7, p 18-27, September 1969. 10 p, 3 fig, 3 photo, 1 tab, 7 ref.

Descriptors: *Thermal pollution, *Radioactive wastes, *Water pollution sources, *Water pollution effects, *Estuaries, Maryland, Nuclear powerplants, Currents (Water), Dispersion, Waste dilution, Ecology, Environment.
Identifiers: Chesapeake Bay, Calvert Cliffs (Md).

The proposed Calvert Cliffs nuclear powerplant will add heat and radioactive material to Chesapeake Bay. Research on possible effects is recommended before construction is authorized. The proposed plant site is on 1135 acres of a sparsely populated section of Calvert County, Maryland, on the shore of Chesapeake Bay. The land is partially forested, and there is farming, raising of beef cattle, and residential use of some areas. Adjacent waters are used for commercial and sport fishing and water sports. The adjacent Bay is six miles wide and a maximum of 110 feet deep, and tidal flows are of greater velocity than elsewhere. It is estimated that a plume of heated water will extend outward from the plant no farther than 2000 feet. This estimate is evidently based upon modeling studies which have not been completed. The judgment to proceed with construction of such large nuclear powerplants is questioned because many environmental and public health hazards have not been satisfactorily investigated or resolved. There is no question that operation of this and other contemplated plants will alter the Bay ecology--the question is how much and in what manner and what the effect will be upon the health and safety of the public. (Knapp-USGS)
W70-04584

EARTH, AIR, WATER,
Southern Illinois Univ., Carbondale. Dept. of Biology.
Justin Frost.
Environment, Vol 11, No 6, p 14-33, July-August 1969. 20 p, 3 fig, 6 tab, 38 ref.

Descriptors: *Pesticide drift, *Water pollution sources, *Path of pollutants, *Persistence, *Antarctic, Fallout, Winds, Atmospheric physics, Air circulation, Air pollution, Precipitation (Atmospheric).
Identifiers: Pesticide distribution (Geographic).

The discovery of pesticides in Antarctic wildlife has provided a dramatic example of the spread of pesticides. The continent, with its ice shelf, lies over 600 miles from the tip of South America, over 1,000 miles from New Zealand, and over 2,000 miles from the tip of South Africa. Yet despite this isolation, insecticides have been detected in seals, in fish, and in penguins and other birds. Since all the tested animals, with the exception of the skua, feed exclusively in Antarctic waters, the presence of pesticide residues in these animals clearly shows that pesticides have been carried into the Antarctic environment in significant amounts from far distant points of origin. Rain falling on the agriculturally remote Shetland Islands has been found to have about the same level of pesticide concentrations as is found in the San Joaquin River although that river receives drainage directly from irrigated fields. One source of contamination of the atmosphere is pesticide-laden dust picked up directly from soils by storms. The principal mechanism by which the atmosphere cleans itself is rainfall, so that the water-insoluble nature of these pesticides means that they will be removed relatively slowly, permitting their accumulation and world-wide dispersal (Knapp-USGS)
W70-04585

OIL TAGGING SYSTEM STUDY, Summary.
Melpar, Falls Church, Va.
For primary bibliographic entry see Field 05A.
W70-04655

OCEAN FALLOUT - THE CRATER LAKE EXPERIMENT,
New York Operations Office (AEC), N. Y. Health and Safety Lab; Lamont-Doherty Geological Observatory, Palisades, N. Y.; Woods Hole Oceanographic Institution, Mass.; and Isotopes, Inc., Westwood, N. J.
H. L. Volchok, M. Feiner, H. J. Simpson, W. S. Broecker, and V. E. Noshkin.
Journal of Geophysical Research, Vol 75, No 6, p 1084-1091, February 20, 1970. 8 p, 2 fig, 4 tab, 31 ref.

Descriptors: *Fallout, *Oregon, *Strontium radioisotopes, Surveys, Sampling, Lakes, Cores, Data collections, Oceans, Pollutants, Precipitation (Atmospheric), Radiochemical analysis, Radioisotopes.
Identifiers: Crater Lake (Oregon), Oceanic fallout.

By the analysis of water and sediment cores, the total inventory of strontium 90 in Crater Lake, Oregon, was determined to be 4.2 curies. In terms of surface fallout, this is equivalent to about 70 mc/sq km. The comparable fallout on the surrounding land area, determined from analyses of soil sections was 58 mc/sq km, and a value predicted by extrapolation from other Oregon stations was 73 mc/sq km. Hence, no substantial difference in the efficiency of fallout collection could be attributed to the mere presence of the large water surface. (Knapp-USGS)
W70-04704

STRONTIUM-90 FALLOUT OVER LAKE MICHIGAN,
Environmental Science Services Administration, Silver Spring, Md.
L. Machta, K. Telegadas, and D. L. Harris.
Work supported by U S Atomic Energy Comm, and Michigan Univ, Great Lakes Res Div. Journal of Geophysical Research, Vol 75, No 6, p 1092-1096, February 20, 1970. 5 p, 3 fig, 2 tab, 22 ref.

Descriptors: *Fallout, *Lake Michigan, *Strontium radioisotopes, Surveys, Sampling, Lakes, Cores, Data collections, Oceans, Pollutants, Precipitation (Atmospheric), Radiochemical analysis, Radioisotopes.
Identifiers: Oceanic fallout.

Measurements of Sr-90 in Lake Michigan water and sediments indicate that fallout is no greater over the lake than over nearby land. Excess 'oceanic' fallout over land fallout is in controversy. The Lake Michigan result favors no enhancement. (Knapp-USGS)
W70-04705

ATMOSPHERIC DUSTS FROM THE NORTH PACIFIC - A SHORT NOTE ON A LONG-RANGE EOLIAN TRANSPORT,
Marathon Oil Co., Littleton, Colo.; and Scripps Institution of Oceanography, La Jolla, Calif.
William S. Ferguson, John J. Griffin, and Edward D. Goldberg.
Journal of Geophysical Research, Vol 75, No 6, p 1137-1139, February 20, 1970. 3 p, 1 fig, 2 tab, 11 ref. Contract AP 00672-02 HEW.

Descriptors: *Sediment transport, *Air circulation, *Dusts, *Bottom sediments, *Pacific Ocean,

Oceans, Clay minerals, Cores, Sampling, Sedimentation.
Identifiers: Atmospheric dusts.

The clay mineral assemblages in atmospheric dusts from the North Pacific are similar to those of the deep-sea sediments from the same area. These results are in agreement with the concept of an eolian transport of solids from the arid areas of Europe and Asia to the marine environment. (Knapp-USGS)
W70-04707

LEACHING OF POLLUTANTS FROM REFUSE BEDS,
Battelle Memorial Inst., Columbus, Ohio; and West Virginia Univ., Morgantown. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05A.
W70-04714

A PRELIMINARY REPORT ON THE CHARACTERISTICS OF A HEATED JET DISCHARGED HORIZONTALLY INTO A TRANSVERSE CURRENT, PART 1 - CONSTANT DEPTH,
Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
H. H. Carter.
Chesapeake Bay Institute Technical Report 61, Reference 69-14, Johns Hopkins University, November 1969. 36 p, 18 fig, 14 ref, append. USAEC Contract AT (30-1)-3109.

Descriptors: *Estuaries, *Thermal pollution, *Mixing, Thermal powerplants, Jets, Hydraulic models, Model studies, Hydraulic similitude, Heated water, Dispersion, Diffusion, Path of pollutants, Water temperature, Hydraulics, Hydrodynamics.
Identifiers: Thermal discharges, Jet discharges.

The behavior of a heated discharge of water jetted at right angles into a moving stream of water was studied using a hydraulic model. The discharge orifice is rectangular to simulate a discharge canal and both the jet stream and receiving waters are confined vertically between a free surface (the sea surface), and a solid level boundary (the sea bottom). Experiments were performed in the circulating water flume in the Hydraulics Laboratory at the Chesapeake Bay Institute. The flume has a free surface test section 3 feet wide, 3 ft. 9 in. deep (3 foot water depth) and 16 feet long. The system is capable of producing water velocities of up to 3.2 feet per sec in the test section. For the heated discharge, a model thermal plant was constructed which consisted of a pump, a flow control system, a rotometer, electric immersion heaters to simulate the condensers, and a temperature sensing and control system to maintain a constant temperature rise between intake and discharge. (Knapp-USGS)
W70-04716

URBAN EFFECTS ON QUALITY OF STREAMFLOW,
Texas Univ., Austin. Environmental Health Engineering Research Lab.
For primary bibliographic entry see Field 04C.
W70-04727

HERBICIDAL PROPERTIES OF SUBSTITUTED INDANS,
Ontario Dept. of Agriculture and Food, Guelph. Provincial Pesticide Residue Testing Lab.
Richard Frank.
Canadian Journal of Plant Science, Vol 49, p 209-215, 1969. 1 fig, 5 tab, 7 ref.

Descriptors: *Herbicides, *Grasses, *Preemergents, *Weeds, Phytotoxicity, Potatoes.
Identifiers: *Indans, Sugar beets, Broadleaved weeds, Preplant treatment, Crabgrass, Greenhouse studies, Growth chamber studies, Field studies.

An appraisal of herbicidal properties of indanyl ethyl ketones was conducted by field, greenhouse, and growth chamber trials. Grasses exhibited varying degrees of susceptibility, but broadleaved weeds proved to be resistant to compounds. Lower temperatures increased phytotoxicity to sugar beets. Preplant and incorporation treatments reduced beet stands more than preemergence treatments. The desired rates of application varied from 1.7 to 3.4 kilogram/hectare. (Wilde-Wisconsin)
W70-04817

YIELDS AND SOURCES OF NITROGEN FROM SEVERAL LAKE ONTARIO WATERSHEDS,
Ontario Water Resources Commission, Toronto. Div. of Labs.
J. H. Neil, M. G. Johnson, and G. E. Owen.
Proceedings, Tenth Conference on Great Lakes Research, University of Michigan, Great Lakes Res Div Publication No 15, p 375-381, 1967. 3 fig, 2 tab, 5 ref.

Descriptors: *Watersheds (Basins), *Lake Ontario, *Nitrogen, Phosphorus, Great Lakes, Land use, Sewage effluents, Surface runoff, Regression analysis, Cyanophyta, Water pollution sources, Eutrophication, Phosphates, Nutrients, Lakes.
Identifiers: *Nutrient sources, *Nutrient yields, Urban watersheds, Rural watersheds, Gross yield, Nitrogen rating curve, Nutrient removal, Seasonal variation, Toronto (Ontario), West Humber River (Ont), German Mills Creek (Ont), Little Rouge River (Ont), Stouffville Creek (Ont), Altona Creek (Ont), Highland Creek (Ont).

The nitrogen yield was estimated from six southern Ontario watersheds, representing rural and urban land uses, on the basis of curves for total nitrogen discharge applied to the hydrograph of each watershed. Mean total annual yield of nitrogen (in pounds/square mile per year) was approximately 3,200 for rural streams, and 34,000 for urban watersheds (includes effluents from a secondary treatment plant). Nitrogen (N) yields for February, March, and April, constituted 58-69% of the annual contribution in rural watersheds, while yields from urban watersheds showed little variation and were greater than spring maxima of rural streams throughout the year. Yields calculated from phosphorus (P) concentration in the same samples indicated a nitrogen to phosphorus ratio of 1.5 in urban watersheds and 8.0 for rural watersheds. Under present conditions of sewage treatment in one urban watershed, 28% of P and 22% of N are removed. Complete removal of both nutrients from the sewage would result in 85% reduction of gross yield of phosphate (25% presently being achieved) and 87% reduction in gross yield of nitrogen (20% presently achieved). (Ketelle-Wisconsin)
W70-04979

NOTES ON ESTUARINE POLLUTION WITH EMPHASIS ON THE LOUISANA GULF COAST,
Public Health Service, Cincinatti, Ohio. Div. of Water Supply and Pollution Control.
K. E. Biglane.
Estuaries, Publication No 83, American Association for the Advancement of Science, Wash, D C, p 690-692, 1967. 3 p, 5 ref.

Descriptors: *Water pollution, *Estuaries, *Pesticides, *Louisiana, Fishkill, Watersheds (Basins), Rivers, Dieldrin, Endrin, Chlorinated hydrocarbon pesticides, Coastal marshes, Water quality, Fisheries, Dredging, Navigation, Industrial wastes, Domestic wastes.
Identifiers: *Estuarine pollution, Lower Mississippi Basin, Atchafalaya River.

Toxic synthetic organic chemicals in water appear to be the cause of continuing fishkills in the lower Mississippi drainage basin. Lethal concentrations of endrin, dieldrin and two unidentified chlorinated hydrocarbons were found in dead or dying fish from the Mississippi and Atchafalaya Rivers. Other cases of fishkills due to pollution of the Louisiana Gulf Coast are cited. Louisiana has 422,000 acres of coastal marshes and estuaries which are very productive as fishery, fur, and recreational areas. Oil and other mineral production, shell dredging, industrial and water quality and the physical character of these areas. The preservation of estuarial land masses is important and every effort should be directed toward this goal. (Carstea-USGS).
W70-05006

STATISTICAL MODELS FOR SURFACE RENEWAL IN HEAT AND MASS TRANSFER,
Argonne National Lab., Ill.
For primary bibliographic entry see Field 08B.
W70-05039

5C. Effects of Pollution

PREDICTING THE EFFECT OF CLEAR-CUTTING ON STREAM TEMPERATURE,
Oregon State Univ., Corvallis. School of Forestry.
For primary bibliographic entry see Field 04C.
W70-04556

STATEMENT OF CONCERN,
Johns Hopkins Univ., Baltimore, Md. School of Hygiene and Public Health.
For primary bibliographic entry see Field 05B.
W70-04584

EFFECTS OF THERMAL AND OTHER FORMS OF POLLUTION ON SOME ANADROMOUS FISHES. PART I,
Rutgers - The State Univ., New Brunswick, N.J.
M. E. Chittenden, Jr., and J. R. Westman.
Available from the Clearinghouse as PB-190 274, $3.00 in paper copy, $0.65 in microfiche. Partial Completion report, Water Resources Research Institute, Rutgers-The State University of New Jersey, Jan 1970. 91 p. OWRR Project B-012-NJ.

Descriptors: *Dissolved oxygen, *Anadromous fish, *Water pollution, Striped bass, Fish.
Identifiers: *Tolerance levels, *Avoidance reactions, *Mortality, *Salinity, Shad.

This is an account of laboratory experiments regarding the vulnerability to some forms of pollution upon young American shad and striped bass, which are anadromous fish passing the estuaries of a number of Eastern rivers. The experiments covered (1)salinity, low temperature, tolerance, and avoidance reactions and oxygen requirements of the shad, (2) effects of Mn (OH)2 settling time on the Winkler dissolved oxygen determination in brackish water, and (3) effect of handling upon the oxygen requirements of the striped bass in fresh and salt waters and (4) oxygen levels at death for the striped bass. (Whipple-Rutgers)
W70-04684

LAKE EUTROPHICATION -- A NATURAL PROCESS,
Geological Survey, Albany, N.Y.
Phillip E. Greeson.
Water Resources Bulletin, Vol 5, No 4, p 16-30, December 1969. 15 p, 6 fig, 2 tab, 44 ref.

Descriptors: *Eutrophication, *Lakes, Nutrients, Water pollution effects, Productivity, Sediments, Urbanization, Water pollution treatment, Algae, Water management (Applied), Limnology.
Identifiers: Eutrophication treatment.

Lake eutrophication is an economic, recreational, and aesthetic problem that affects every lake of the world. Eutrophication is the natural process of lake aging, and progresses irrespective of man's activities. Pollution, however, can hasten the natural rate of aging and shorten the life expectancy of a body of water. The eutrophication of a lake consists of the gradual progression from one life stage to another based on the degree of nourishment or productivity. The extinction of a lake is attributed

to enrichment by nutritive materials, biological productivity, decay, and sedimentation. Presently used methods for retarding eutrophication are the abatement of cultural enrichment, treatment of eutrophic symptoms, and control of fundamental causes. (Knapp-USGS)
W70-04721

THE ADAPTATION OF PLANKTON ALGAE. III. WITH SPECIAL CONSIDERATION OF THE IMPORTANCE IN NATURE,
Royal Danish School of Pharmacy, Copenhagen. Dept. of Botany.
For primary bibliographic entry see Field 02H.
W70-04809

EUTROPHICATION TESTING PROGRAM FOR MINNESOTA'S 'SKY BLUE WATERS',
Schoell and Madson, Inc., Hopkins, Minn.
For primary bibliographic entry see Field 02H.
W70-04810

DISTINCTION BETWEEN BACTERIAL AND ALGAL UTILIZATION OF SOLUBLE SUBSTANCES IN THE SEA,
Marine Lab., Aberdeen (Scotland); and Indiana Univ., Indianapolis. Dept. of Microbiology.
A. L. S. Munro, and T. D. Brock.
Journal General Microbiology, Vol 51, p 35-42, 1968. 3 fig, 1 tab, 14 ref, 3 plates.

Descriptors: *Aquatic bacteria, *Algae, *Analytical techniques, *Marine microorganisms, Physiological ecology, Organic matter, Water pollution effects, Diatoms, Carbon radioisotopes, Kinetics, Tritium, Chlorophyll.
Identifiers: *Heterotrophy, *Organic solutes, *Marine environments, Microbial ecology, Fluorescence microscopy, Acetate, Carbon-14, Autoradiography, Michaelis-Menten equation, Loch Ewe (Scotland), Scotland, Phaeopigments, Acridine orange, Lineweaver-Burke equation.

Staining with acridine orange and direct observation with fluorescence microscopy demonstrates numerous viable bacteria and diatoms attached to sand grains of a littoral beach to depths exceeding 10 centimeters. Kinetic analysis of uptake of radiocarbon-labelled acetate over range, 10-5000 micrograms/liter, demonstrates two uptake mechanisms: one, saturable at lower concentrations (Michaelis-Menten kinetics), and another, describable as diffusion, the latter having been attributed by others to algal uptake. Autoradiography, however, reveals that bacteria alone are responsible for uptake of tritiated acetate. In those situations where Michaelis-Menten kinetics applied, maximum attainable uptake rates (V) were much greater than any previously reported for water, such values for V being attributable to larger microbial populations in sand. Since reasons for existence of two types of kinetics are obscure, it is dangerous to make conclusions regarding microbial heterotrophy based on kinetic analysis alone. Based on these studies, it seems clear that algal heterotrophy is negligible in sea waters, and that autoradiography is an effective tool in studies of energetics and trophic relationships in microbial ecology. (Eichhorn-Wisconsin)
W70-04811

VERTICAL DISTRIBUTION OF ZOOPLANKTON IN RELATION TO THE EASTERN PACIFIC OXYGEN MINIMUM,
California Univ., San Diego, La Jolla. Inst. of Marine Resources.
Alan R. Longhurst.
Deep-Sea Research, Vol 14, p 51-63, 1967. 3 fig, 3 tab, 22 ref

Descriptors: *Zooplankton, *Vertical migration, *Sampling, Biomass, Anaerobic conditions, Coasts, Diatoms.
Identifiers: *Vertical distribution, *Plankton sampler, Nocturnal migration, Coastal upwelling, California Current, Baja California, Calanus helgolandicus.

The use of a new plankton sampler assisted to evaluate the presence of a dense population of Calanus helgolandicus and other plankters below 150 meters in the southern part of the California Current in oxygen-deficient water (0.2 milligrams/liter of oxygen). Several species of this deoxygenated zone perform nocturnal migrations to upper strata with oxygen tension up to 5.0 milligrams/liter. The unusual abundance of the fauna in the deoxygenated layer is attributed to the effects of the local coastal upwelling followed by rapid diatom blooms along the coast of California peninsula. (Wilde-Wisconsin)
W70-04815

SEASONAL AND VERTICAL DISTRIBUTION OF THE ZOOPLANKTON IN THE ASKO AREA (NORTHERN BALTIC PROPER) IN RELATION TO HYDROGRAPHICAL CONDITIONS,
Stockholm Univ. (Sweden). Dept. of Zoology; and Stockholm Univ. (Sweden). Asko Lab.
Hans Ackefors.
Oikos, Vol 20, No 2, p 480-492, 1969. 13 fig, 14 ref.

Descriptors: *Zooplankton, *Seasonal, Temperature, Light, Salinity, Vertical migration.
Identifiers: Vertical distribution, Asko area (Baltic Sea), Synchaeta, Podon polyphemoides, Acartia bifilosa, Eurytemora.

Sampling of zooplankton in intervals of 2.5 meters to 36 meters depth revealed seasonal and vertical distribution of rotifers, cladocerans, copepods, and other plankters. The maximum density of organisms of 650 specimens per 23 liters was observed from the end of July to the middle of September. Synchaeta spp attained the greatest density from July until part of September, whereas Podon polyphemoides was largely confined to 15 meters depth in July and August. Acartia bifilosa was present at all depths to 35 meters and was especially abundant in September, December, and March. Eurytemora spp were evenly distributed from bottom to the surface and attained maximum density in summer and fall. Salinity varied from 0.62 to 0.70% at the surface, and from 0.67 to 0.78% at the bottom. (Wilde-Wisconsin)
W70-04816

INTERACTIONS BETWEEN THE RATES OF PRODUCTION OF A FRESHWATER MACROPHYTE AND PHYTOPLANKTON IN A POND,
Hull Unov. (England). Dept. of Botany.
For primary bibliographic entry see Field 02H.
W70-04818

MANAGING THE GREAT LAKES WATER RESOURCE,
North Carolina Univ., Chapel Hill. School of Public Health.
For primary bibliographic entry see Field 06B.
W70-04848

PRODUCTIVITY OF PHYTOPLANKTON AND QUANTITIES OF ZOOPLANKTON AND BOTTOM FAUNA IN RELATION TO WATER QUALITY OF LAKE ASHTABULA RESERVOIR, NORTH DAKOTA,
North Dakota State Univ., Fargo. Div. of Natural Sciences.
For primary bibliographic entry see Field 02H.
W70-04855

TO PREVENT AN UNNATURAL DEATH.
Open Lands Project, Chicago, Ill.

Summary of Proceedings of Four-State Lake Michigan Conference, Chicago, Illinois, April 1969. 30 p.

Descriptors: *Lake Michigan, Illinois, Indiana, Wisconsin, Michigan, Thermal pollution, Industrial wastes, Sewage treatment, Landfills, Chemical wastes.

The threats to Lake Michigan are seen as (1) thermal pollution; (2) sewage and industrial wastes; (3) agricultural chemicals; (4) landfill; and (5) unplanned shoreline development. Statements from various advocacy groups from the four states participating give indication of strong citizen concern about the deterioration of Lake Michigan waters. All participants agreed upon viewing Lake Michigan in a holistic manner so as to consider all the implications of the intra and inter-relationships peculiar to the lake. Recommendations from the Conference included a proposal that a major effort be directed to total planning for the lake in order to detect quickly ecological imbalances which occur so that they can be remedied before they become irreversible. (Starr-Chicago)
W70-04898

PLANKTON DIATOM ASSEMBLANCES IN LAKE MICHIGAN,
Michigan Univ., Ann Arbor.
Eugene F. Stoermer, and J. J. Yang.
University of Michigan, Ann Arbor, Great Lakes Research Division, Special Report No. 47, 1969. 268 p, 65 ref.

Descriptors: Phytoplankton, *Diatoms, Lake Michigan, Eutrophication.
Identifiers: Diversity index, *Thermal bar.

Detailed analyses are presented of plankton diatom populations occurring in modern collections from all parts of the lake as well as collections from the Chicago area dating back to 1876. Records of occurrence and population frequency are given for 714 taxonomic entities. Diversity and redundancy indices were calculated for the assemblages examined. Study showed increasing incursion of pollution tolerant forms into the Lake Michigan flora. Species which have caused objectional blooms in recent years in southern Lake Michigan first occurred in collections taken in the 1930's and now are found in all parts of the lake. Species associated with extreme water quality degradation in Lake Erie have recently been introduced into Lake Michigan. At the present time extreme differences are noted between the nearshore flora and that of the open lake, particularly during thermal bar conditions in the spring. On the basis of floristic analysis the author's general conclusion is that Lake Michigan at the present time is approaching the break-point between transient algal nusiances confined to the inshore area and more drastic changes affecting the entire ecosystem.
W70-04902

5D. Waste Treatment Processes

PHOTOLYSIS MECHANISMS FOR POLLUTION ABATEMENT,
IIT Research Inst., Chicago.
Layton C. Kinney, and Victor R. Ivanuski.
Available from the Clearinghouse as PB-190 169, $3.00 in paper copy, $0.65 in microfiche. Robert A. Taft Water Research Center Report No TWRC-13, Federal Water Pollution Control Administration, October 1969. 46 p, 13 fig, 11 tab, 10 ref, 1 append. FWPCA Project 17050---10/69, Contract No 14-12-433.

Descriptors: *Pollution abatement, *Water pollution control, *Sewage, Industrial wastes, Domestic wastes, Organic matter, Irradiation, Titanium, Sands, Streams, Lakes.
Identifiers: *Photolysis, *Photocatalysts, Photocatalytic oxidation.

Photocatalytic oxidation of dissolved organic matter by irradiation of slurries of zinc titanate, zinc oxide, titanium dioxide, and beach sand was studied using sunlamps. The reaction appears to follow first order kinetics in most cases. Zinc oxide

appears to be a superior catalyst for this purpose. Photocatalysts are widely distributed in nature, and photolytic oxidation is a mechanism whereby dissolved organic matter is oxidized in the natural environments of streams and lakes. Photolytic oxidation reduced the dissolved organic matter in a sample of domestic sewage by 50% and 75% during 24 hours and 70 hours, respectively. The limiting factor appears to be the activity of the photocatalyst. The most promising area of photolysis application will be in problems of industrial disposal where the concentrations of organic matter are high. (Carstea-USGS)
W70-04546

MATHEMATICAL MODEL OF TERTIARY TREATMENT BY LIME ADDITION,
General American Transportation Corp., Niles, Ill.
General American Research Div.
L. Seiden, and K. Patel.
Available from the Clearinghouse as PB-190 170, $3.00 in paper copy, $0.65 in microfiche. Robert A. Taft Water Research Center Report No TWRC-14, Federal Water Pollution Control Administration, September 1969. 69 p, 10 fig, 5 tab, 152 ref, 3 append. FWPCA Project 17010---9/69, Contract No 14-12-416.

Descriptors: *Mathematical models, *Tertiary treatment, *Lime, *Phosphorus compounds, *Computer programs, Effluents, Acidity, Cost analysis, Streams, Streamflow, Flow rates, Coagulation.
Identifiers: Secondary effluents, *Phosphorus removal.

The status of phosphorus removal from secondary effluents by lime addition is presented. Based on the empirical information available, a mathematical model of the process was developed. The factor which best correlated with phosphorus removal was the pH of the tertiary effluent. Cost information for the model was generated based on a solids-contact type precipitator such as the Infilco Densator. A computer program, in FORTRAN IV, derived from the model, was developed for use as a subroutine in the FWPCA Executive Calling Program. Given the input stream flow rate and analyses, and the final pH, the program computes the necessary doses of lime and coagulant, their costs, the size and cost of the equipment, the degree of phosphorus removal, and the output stream analyses. (Carstea-USGS)
W70-04547

APPRAISAL OF GRANULAR CARBON CONTACTING: PHASE 1. EVALUATION OF THE LITERATURE, AND PHASE 2. ECONOMIC EFFECT OF DESIGN VARIABLES,
Swindell-Dressler Co., Pittsburgh, Pa.
A. E. Cover, and L. J. Pieroni.
Available from the Clearinghouse as PB-190 168, $3.00 in paper copy, $0.65 in microfiche. Robert A. Taft Water Research Center Report No TWRC-11, Federal Water Pollution Control Administration, May 1969. 109 p, 33 fig, 21 tab, 58 ref. FWPCA Project 17020---5/69, Contract No 14-12-105.

Descriptors: *Reviews, *Waste water treatment, *Activated carbon, Tertiary treatment, Organic matter, Wastes, Chemical oxygen demand, Particle size, Economics, Costs, Flow, Adsorption, Bibliographies, Surveys.
Identifiers: Granular carbon filters.

A literature review of tertiary waste water treatment gives special attention to activated carbon adsorption of chemical oxygen demand (COD), allowable capacity (loading) of carbon with organic waste matter, carbon particle size, and number of regeneration cycles on adsorption capacity and rate. The economic effects of shop fabrication and field erection of vessels, surge designs, plant size, idle carbon inventory, velocity, contact time, particle size, regeneration loss, carbon capacity, material costs, number of contacting stages, and in-place regeneration are discussed. Most of the data were collected from carbon treatment plants at Pomona (California), Lake Tahoe (California), Nitro (West Virginia), Washington (New Jersey), and Lebanon (Ohio). Recommendations are made for further evaluation and experimental work. (Carstea-USGS)
W70-04548

APPRAISAL OF GRANULAR CARBON CONTACTING: PHASE 3. ENGINEERING DESIGN,
Swindell-Dressler Co., Pittsburgh, Pa.
A. E. Cover, and C. D. Wood.
Available from the Clearinghouse as PB-190 167, $3.00 in paper copy, $0.65 in microfiche. Robert A. Taft Water Research Center Report No TWRC-12, Federal Water Pollution Control Administration, May 1969. 40 p, 4 fig, 1 tab, 5 ref, 3 append. FWPCA Project 17020---5/69, Contract No 14-12-105.

Descriptors: *Cost analysis, *Activated carbon, *Tertiary treatment, *Design criteria, Waste water treatment, Economics, Engineering structures, Equipment.
Identifiers: *Granular carbon.

The engineering design and cost estimate of a 10 million-gallon-per-day plant for tertiary treatment of waste water with granular activated carbon contains the process description, design bases, plant operation, control rationale, equipment list, equipment specifications and cost estimate. This design incorporates reliability, economy and current state-of-the-art technology. Although not fully proven in practice, it is based upon the application of mature engineering judgement to available data and offers economies over any other plant which has been successfully demonstrated. (Carstea-USGS)
W70-04549

CHARACTERISTICS OF WOOL DYEING WASTES AND EXPERIMENTAL TREATMENT,
J. A. McCarthy.
Sanitalk, Vol. 1, p 8-11, 1952.

Descriptors: *Test procedures, *Trickling filters, *Waste water treatment, Coagulation, Sedimentation, Lagoons, Biochemical oxygen demand.
Identifiers: *Wool dyeing wastes, *Color removal, Dyeing wastes, Vat dyeing waste, Filter loading, Top dyeing waste.

This report studied the use of experimental trickling filters for treating the two types of wool dyeing wastes. The top dyeing waste contains little suspended matter and much of the BOD is in solution. Ordinary coagulates are generally ineffective and even prolonged sedimentation gives little improvement. Storage in lagoons may result in some reduction in color, but little reduction in BOD. With standard trickling filters it was found that loadings of 1000 to 1500 pounds of BOD per acre foot resulted in a BOD reduction of 90%. Recirculating the wastes through the filters with a ratio of 5 to 1 showed that BOD loading could be gradually increased to 5000 lbs./acres ft. with an 89% reduction in BOD. Vat dyeing wastes while lower in BOD, required a reduction in filter loading to 1000 lbs. of BOD per acre foot in order to obtain a 90% reduction. Recirculation of this waste through the filters increased the loading only 30 to 40 percent. As both types of dye wastes are customarily found in the same mill combing these two wastes gave satisfactory effluent through trickling filters with loadings of 1200 lbs. of BOD per acre foot. (Livengood and Mattox - North Carolina State University)
W70-04586

RIVER POLLUTION IN INDUSTRIAL AREAS: AN INSOLUABLE PROBLEM,
L. Klein.
Institute of Sewage Purification Journal and Proceedings, p 503 511, 1961. 16 ref.
Identifiers: *Turbine aeration.

Special difficulties facing river boards in highly industrial areas of England, Wales, and Scotland are: (1) multiple pollution in small river, (2) inadequate dilution water, (3) intractable nature of certain trade effluents, and (4) high cost of purifying sewage and trade effluents. Possible ways of improving rivers in these areas are (1) stricter standards for sewage effluents, (2) improved setting for sewer storm overflows, (3) discharge of trade effluents to sewers, (4) use of clean water to dilute effluents, (5) treatment of river water. Turbine aeration is a practical method of increasing the dissolved oxygen content of river water passing through hydroelectric installations. The Swedes increase dissolved oxygen content by bubbling compressed air into water through a perforated plastic tube. Perhaps the most satisfactory method of dealing with a grossly polluted river is a complete treatment plant containing settling equipment and an activated sludge process. (Robinson - North Carolina State University)
W70-04587

EFFECTS OF TRADE EFFLUENTS ON ACTIVATED SLUDGE TREATMENT AND OBSERVATIONS UPON RESIDUAL IMPURITIES IN EFFLUENTS,
Bolton and District Joint Sewage Board.
Peter Brown.
Institute of Sewage Purification Journal and Proceedings Part 3, p 267-271, 1963.

Descriptors: *Activated sludge, *Biochemical oxygen demand, Waste water treatment.
Identifiers: *Finishing wastes, Starch.

The investigation is confined to a laboratory scale-activated sludge process. If the waste contained very little else but starchy products, the permanganate value and BOD drop to the level of the control sample after a short period of further aeration. The experiment on trade effluent containing starchy material seems to indicate that a higher initial BOD loading was not necessarily the cause of extra residuals in the effluents. Certain trade effluents contribute residual impurities to a sewage works' final effluent. Under test conditions, residuals increase the permangate value of the effluent to a greater extent than the BOD. The presence of residuals should be a major consideration when deciding whether a trade effluent can be accepted for treatment at a sewage works. (Robinson - North Carolina State University)
W70-04588

ECONOMICS OF ARTIFICIAL RECHARGE FOR MUNICIPAL WATER SUPPLY,
Resources for the Future, Inc., Washington, D.C.
For primary bibliographic entry see Field 04B.
W70-04614

TRADE EFFLUENT CONTROL IN THE CARPET INDUSTRY,
Trent River Board (Gt. Brit.).
D. Evers.
Textile Institute and Industry, Vol. 3, p237-240, 1966.

Descriptors: *Water pollution, *Biochemical Oxygen Demand.
Identifiers: *Wool scouring, *Carpets, Dyeing, Sizing, Latices, Moth-proofing, Mildew resistance treatments, Sulfuric acid, Caustic, Heat pollution, Wool grease, Wool.

The processes causing water pollution are (1) scouring of wool, (2) dyeing, (3) sizing the carpet backing, (4) latexing, and (5) moth and mildew proofing. Scouring of wool is by far the worst source of pollution, but this can be materially reduced by (1) acid cracking with sulfuric acid or (2) by the use of calcium chloride. Either allows much of the wool grease and other impurities to be removed as solids from the effluent water obtained from scouring. Four tables present numerical data. Dyehouse effluents may have pH values as low as 2 and require alkaline treatment, but they are also

very hot and may require cooling lest they cause overheating in the sewage disposal plant. The back sizing with starch or glue is a minor source of water pollution. Latexing effluents may be treated with acid to precipitate the latex and whiting. Moth and mildew proofing may result in acid which can be neutralized or fluorides, which if excessive, can be precipitated with a barium compound. It is concluded that effluents from carpet mills must be individually studied and each handled as a separate problem. (Work-North Carolina State Univ)
W70-04625

TREATMENT OF WOOL WASTES,
Purdue Univ., Lafayette, Ind. Engineering Extension.
A. M. Buswell, and H. F. Mueller.
Proceedings of the Eleventh Industrial Waste Conference, Series No. 91, p.160-165, 1956.

Descriptors: *Anaerobic digestion.
Identifiers: *Wool, *Wool grease, Lanolin, Experimentation.

In the scouring of raw wool with soap and alkali to remove foreign matter, the waste waters have an extremely high BOD and are very polluting. The usual method of treatment involves addition of H2SO4 and sedimentation to remove grease and sludge, but the sedimentation tank effluent still requires dilution before discharge to the sewers. Wool grease consists of the suint and fat (largely lanolin). Experiments were made on raw wool wherein it was submitted to anaerobic fermentation. Most of the grease and other organic contaminants, other than lanolin, were decomposed and the wool fibers were unharmed. Sand and solids settled. Potash can be concentrated. No large scale trials are reported. (Work-North Carolina State Univ)
W70-04626

SODIUM HYDROXIDE RECOVERY IN THE TEXTILE INDUSTRY,
Purdue Univ., Lafayette, Ind.
C. S. Carrique, and L. U. Jauregui.
Proceedings of the 21st Industrial Waste Conference, Engineering Extension Series No. 1212, Vol. 50, Part 2, p861-868, 1966.

Descriptors: Costs.
Identifiers: *Textile mill wastes, *Caustic, Mercerizing, Cotton fabrics.

Because of the high cost of caustic in Argentina, it is recovered from the operations of a textile mill processing 2,000 metric tons of cotton per year. The caustic is mainly used in the mercerizing process. The caustic solution is filtered, concentrated in a two-stage evaporator, and refiltered for reuse. A saving of about $20,000 (U.S.) per year is achieved and water pollution is prevented. (Work-North Carolina State Univ)
W70-04637

THE ECONOMICS OF URBAN SEWAGE DISPOSAL,
California Univ., Riverside. Dept. of Economics.
Paul B. Downing.
Available from Frederick A. Praeger, Publishers, 111 Fourth Avenue, N.Y., N.Y. 10003, for $15 per copy. New York: Frederick A. Praeger, Publishers, 1969. 196 p, 38 tab, 13 fig, 58 ref, 1 append.

Descriptors: *Evaluation, *Cost-benefit analysis, *Sewage disposal, Sewers, Cost comparisons, Costs, Cost analysis, Estimated costs, Estimated benefits, Wastewater disposal, Domestic wastes, Municipal wastes, Marginal costs.
Identifiers: Wastewater treatment costs, Wastewater collection costs, Garbage grinders, Effluent charges.

Cost-benefit analyses were applied to the collection and treatment of urban sewage (excluding storm water runoff) with the following results: (1) The cost per capita per million gallons per day of volume for collection, transmitting, and treating sewage declined as the number of people served increased. (2) A net savings of $1.55 per person yearly would accrue to a municipality if individual garbage grinders were used in lieu of garbage collection. (3) To assess the cost of the variation in flow in a fixed-capacity treatment plant, the cost of increasing the sewer capacity reserved for each individual by 25 gallons per day was estimated to be 3 cents per capita per year per mile of sewer. (4) If a plant serving 100,000 people were increased in capacity to treat the expected hourly peak flow at 90 percent, the cost of treatment would increase from $2.07 to $3.48 per capita per year. (5) Treatment facilities should be expanded to service urban 'fringe' areas, if soil conditions are poor and if there is a net external cost to the septic tank system. (6) The marginal cost of serving an increase in urban population density was estimated to be 64 cents per capita per year. (7) For a hypothetical urban complex of 102,400 people, with varying population densities, one treatment plant was always cheaper than two plants. (8) A city of 10,000 would have to be less than ten miles from the edge of a city of 100,000 before it would be economical to send the small city's sewage to the large city's plant. (9) Large savings in pollution damage would be necessary before a regional treatment plant would be economically feasible. (10) The effluent charge system for waste discharge should be adopted to enhance the 'stream standard' for water quality. (11) Three special charges to aid financing of urban sewage facilities were suggested: (a) A special adjustment of rates to allow for differences in sewage strength for large industrial customers, (b) A higher peak load price for large customers who release widely varying loads, and (c) A special charge for customers who do not install a garbage grinder.
W70-04648

DILUTE SOLUTION REACTIONS OF THE NITRATE ION AS APPLIED TO WATER RECLAMATION,
Robert A. Taft Water Research Center, Cincinnati, Ohio. Advanced Waste Treatment Research Lab.
Frank C. Gunderloy, Jr., Cliff Y. Fujikawa, V. H. Dayan, and S. Gird.
Available from the Clearinghouse as PB-190 195, $3.00 in paper copy, $0.65 in microfiche. Federal Water Pollution Control Administration, Cincinnati, Ohio, Robert A. Taft Water Research Center Report No. TWRC-1, Oct, 1968. 67 p, 14 tab, 232 ref, 1 append. FWPCA Project 17010---10/68, Contract No. 14-12-52.

Descriptors: *Nitrates, Wastewater treatment, *Denitrification, Catalysis, Bibliographies, *Reduction (Chemical), *Water reuse, Chemical reactions.
Identifiers: Ferrousion, Cupric ion.

A new and unexpected partial denitrification of dilute nitrate ion solutions (10 to 50 ppm NO3-N) has been achieved by treatment with 8 moles of ferrous sulfate per mole of nitrate in unbuffered alkaline reactions. The nitrogen loss, which probably represents evolution of N2 or N2O, has been as high as 50%. Total reduction to lost nitrogen plus nitrite and/or ammonia has approached 100%. The reduction takes place in the presence of partially oxidized black iron hydroxides, and requires catalytic quantities of cupric ion. Denitrification is suppressed by phosphates, as well as by several other factors, some as yet unidentified. Silver ion catalysis or a 16-fold excess of the ferrous salt permits reduction to ammonia in the presence of phosphate, but there is no accompanying denitrification. A literature survey resulted in the selection of 232 references.
W70-04652

PROBABILISTIC VARIATIONS IN ULTIMATE FIRST STAGE BOD,
Illinois State Water Survey, Peoria. Water Quality Section.
Veerasamy Kothandaraman.
ASCE Proceedings, Journal Sanitary Engineering Division, Vol 96, No SA1, Paper 7054, p 27-34, February 1970. 8 p, 3 fig, 1 tab, 9 ref, append

Descriptors: *Biochemical oxygen demand, *Biochemistry, Oxidation, Oxygen sag, Dissolved oxygen, Probability, Sewage treatment, Water pollution effects, Statistical methods, Statistical models.
Identifiers: Biochemical reaction rates.

Variations in the ultimate first stage BOD are found to be lognormally distributed under the hypothesis that the bacterial oxidation of organic matter is a first order reaction, and that the deoxygenation coefficient is normally distributed with known parameter values of mean and variance. In the exponential decay curve for the ultimate first stage BOD, the variance in predicting ultimate BOD increases with increase in time. Expressions for the mean, variance, and modal values of the ultimate first stage BOD are presented. (Knapp-USGS)
W70-04711

GROUNDWATER RECHARGE DESIGN FOR RENOVATING WASTE WATER,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
Herman Bouwer.
ASCE Proceedings, Journal Sanitary Engineering Division, Vol 95, No SA1, Paper 7096, p 59-74, February 1970. 16 p, 10 fig, 1 tab, 20 ref.

Descriptors: *Artificial recharge, *Water spreading, *Water reuse, *Tertiary treatment, Infiltration, Filtration, Sewage treatment, Sewage disposal, Hydrogeology, Groundwater movement, Water resources development, Reclaimed water.
Identifiers: Phoenix (Ariz), Salt River (Ariz).

Soil and hydrogeologic conditions permitting, groundwater recharge by surface spreading is an economic and esthetic way for further treatment or renovation of secondary sewage effluent, cannery wastes, or similar low-quality water. The design of a system of spreading areas with wells or drains for collecting the reclaimed water should generally be based on: (1) A maximum limit for the elevation of the water table mound beneath the spreading areas; (2) a minimum limit for the underground detention time and travel distance as the water moves to the wells or drains; and (3) minimum contamination of the groundwater in the aquifer outside the recharge system. Hydraulic properties of aquifers, including anisotropy, can be determined by analog and by field measurements. These data are used to evaluate the effective transmissibility for recharge, and to calculate water-table positions and underground detention times for a system of long, parallel spreading strips with wells midway between the strips. (Knapp-USGS)
W70-04712

A STUDY ON TREATMENT OF WOOL SCOURING LIQUORS,
Lawrence Experiment Station, Mass.
J. A. McCarthy.
Sanitalk, Vol. 3, No. 3, p17-18, 1955.

Descriptors: *Waste water treatment, *Coagulation, Test procedures, Hydrogen ion concentration, Recirculated water, Calcium chloride.
Identifiers: *Wool grease recovery, *Biological filtration, *Scouring waste, Liquor treatment, Wool scouring liquors, Recirculating filters.

Studies on the treatment of wool scouring waste waters made by the Lawrence Experiment Station, Massachusetts, have shown that coagulation with CaCl2, usually 2% by weight, with the introduction of live steam with adjustment of pH value gives up to 98% reduction in concentration of grease and 66% reduction in BOD. The treated waste waters still contain about 500-800 ppm grease and have a BOD of 4000-7000 ppm. To assess the permissible loading and probably removal of BOD in treatment of the waste waters by biological filtration, several series of filters were operated, the liquor being ap-

plied in a mixture with rinsing waters which are usually available in volumes 3 to 10 times greater than those of scouring waste waters and have a relatively low BOD and grease content. The loading applied to the filters was usually 2000 lbs/acre-ft. and the proportion of liquor to rinsing waters applied to two recirculating filters in series varied from 25% to 10% scouring liquor, the corresponding reduction in BOD of the mixture increasing from 60 to 83%. The grease content was reduced by 90%. These results indicate that wool scouring liquors with a BOD of 16,000 before coagulation can be treated by two-stage biological filtration after dilution with 90% rinsing waters. (Livengood-Mattox-North Carolina State Univ)
W70-04743

ADVANCES IN WATER QUALITY IMPROVEMENT-WATER RESOURCES SYMPOSIUM NO. 1.
Texas Univ., Austin.

Edited by Earnest F. Gloyna and W. Wesley Eckenfelder, Jr. Austin, Texas, University of Texas Press, 1968. 513 p.

Descriptors: *Waste disposal, *Wastewater treatment, *Streams, *Rivers, *Biological treatment, *Industrial wastes, *Pollution abatement, Ecology, Biological properties, Anaerobic digestion, Flocculation, Filtration, Surfactants, Eutrophication, Lakes, Saline water.
Identifiers: *Waste stabilization ponds, *Biological oxidation, *Anaerobic treatment, Activated sludge plants, Aerated lagoons, Mathematical modeling of mixing.

Text consists of a series of 38 special lectures presenting current practices and advances in wastewater analysis, treatment and disposal. The text reflects its stated objective of demonstrating that wastewater management encompasses virtually every water resource activity. Section One of the book discusses the broader aspects of water resources conservation, the transport and dispersion of wastes in streams and the ecology of aquatic environments. The special lectures indicate the many facets of these factors which involve problems in economics, management, hydraulics, stream ecology, and mathematical modeling of various mixing phenomenon. Section Two contains lectures which examine and explain current specific concepts and theories in advanced biological waste treatment, including illustrations of the most recent improvements in process design. Section Three discusses current trends and advances in: (1) low-cost treatment practices, (2) use of waste stabilization ponds for biological treatment of wastewater containing organic pollutants, (3) development of design criteria and relevant significant innovations. (See also W70-04762 thru W70-04794). (D'Arezzo-Texas)
W70-04761

WATER RESOURCES VALUES,
Resources for the Future, Inc., Washington, D.C.
Allen V. Kneese.
Advances in Water Quality Improvement, (Editors: E. F. Gloyna and W. W. Eckenfelder, Jr), Austin, Texas, Univ of Texas Press, 1968, p 3-8, 3 ref.

Descriptors: *Cost-benefit analysis, *Cost comparisons, *Industrial water, *Municipal water, *Value, *Waste treatment, Water quality, Water resources, Pollutants, Cost analysis, Municipal wastes, Dissolved oxygen, Management.
Identifiers: *Economic and system analysis, *Regional systems approach, *Low-quality water treatment, ORSANCO, INCODEL, Delaware River estuary, Clean Rivers Restoration Act, Hudson River, Rhine River, Philadelphia.

A discussion of water resources values is presented stemming from the basic premise that the net value of water quality in water courses is a function of both the benefits resulting from improved water quality versus costs of attaining the specified quality. Author finds that while progress has been made in pollution control, serious problems continue, notably the problem of residuals in treated municipal wastes and control of industrial waste. The regional systems approach is suggested for the solution of the water pollution problems. Conclusions are reached that both costs and gains of quality improvement must be considered in determining the maximum net value of rivers. Finally, it is contended that scientific and engineering developments can be applied rationally and systematically provided their economic and institutional impacts also are understood and considered in the evaluation process. As illustration, municipal waste treatment costs double when waste removal from effluent is increased from 90% to 96-97%. Costs triple in increasing removals from 97% to 100%. Also cited are the cost implications of various alternatives regarding increased dissolved oxygen states in the Delaware River estuary. (See W70-04761). (D'Arezzo-Texas)
W70-04762

ECOLOGICAL CHANGES IN A POLLUTED ENVIRONMENT.
Illinois Univ., Urbana.
John H. Austin, and R. S. Englebrecht.
Advances in Water Quality Improvement, (Editors: E. F. Gloyna and W. W. Eckenfelder, Jr.), Austin, Texas, Univ of Texas Press, 1968, p 9-20, 7 fig, 3 tab, 23 ref.

Descriptors: *Ecology, *Nutrients, *Dissolved oxygen, *Bacteriophage, *Viruses, *Biological communities, Biological treatment, Chemical analysis, Temperature, Oxygen demand, Velocity, Waste treatment, Wastewater treatment, Benthos.
Identifiers: *Long-term ecological changes, *Flow factors, *Persistence of bacteria, Nematode concentration, Salmonellae, Benthic community, Nutritional groups.

The discussion ensues from two basic questions: (1) How might the information available today be used to predict the effect of waste on a given stream. (2) If the knowledge available today is inadequate, what additional information is needed. The authors suggest that the study of ecological changes in a polluted aquatic environment is an experiment in the inter-relationships of the scientific disciplines involved. Thus, the individual efforts of chemists, biologists, engineers, and others are presented to demonstrate the durability of correlated efforts to understand the ecological changes in a polluted environment. For example, biochemical process of oxygen utilization may be controlled in part by a physical process such as the stream velocity in which the organism lives. The coliform titer of a stream may be greater when receiving a chlorinated wastewater effluent than an unchlorinated (but otherwise comparable) effluent. Conventional bacteriological indicators of pollution may be misleading insofar as viral contents are concerned. Only by detailed analysis of the many-faceted ecological picture can some of the complicated problems of the polluted environment be solved. (See W70-04761). (D'Arezzo-Texas)
W70-04763

OBJECTIVES, TECHNOLOGY, AND RESULTS OF NITROGEN AND PHOSPHORUS REMOVAL PROCESSES,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
Karl Wuhrmann.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F. and Eckenfelder, W. W., Jr.), Austin, Texas, Univ of Texas Press, 1968. p 21-48, 11 fig, 8 tab, 35 ref.

Descriptors: *Activated sludge, *Costs, *Cost comparisons, *Denitrification, *Phosphorous compounds, *Nitrogen compounds, *Sewage, *Biological treatment, Design, Phosphates, Concentration, Temperature, Lime, Iron Pollutants.
Identifiers: *Endogenous denitrification, *Post-precipitation, *Sludge loads, *Sedimentation curve, *Precipitation unit, Nutrient removal, Anaerobic plants, Final effluent, Settled sewage, pH, Iron (III).

Discussed are the objectives of nutrient removal processes, the types and amounts of nutrients to be removed and the perspective success of tertiary treatment. Paper analyzes procedures for the elimination of phosphorus from sewage, including a thorough explanation of iron (III) as a precipitant, phosphorus elimination using lime and, phosphorus removal using both lime and iron (III). The removal of nitrogen compounds from sewage is discussed from the viewpoints of general process layout, the process of nitrification in activated sludge treatment, denitrification by activated sludge, the role of oxygen as a limiting factor, the respiration substrates as limiting factors and results of practical experiments with denitrification conducted at a pilot plant station. Discussed are certain cost-justifiable, beneficial side effects of nitrogen and phosphorus removal processes. Also presented are detailed estimates of annual and net operation costs and design factors for phosphorus and nitrogen removal plants. Conclusions are reached that the conventional biological treatment will still represent the basis of all further purification steps, both for economic and process reasons. Further, past scientific and monetary investment in sewage purification will not lose its value, not even in view of eventual totally new procedures generated by demands for much higher, sewage effluent qualities. (See W70-04761). (D'Arezzo-Texas)
W70-04764

BIOLOGICAL RESPONSES TO NUTRIENTS-EUTROPHICATION: PROBLEMS IN FRESHWATER,
Texas Univ., Austin.
E. Gus Fruh.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F. and Eckenfelder, W. W., Jr.), Austin, Texas, Univ of Texas Press, 1968. p 49-64, 7 tab, 82 ref.

Descriptors: *Eutrophication, *Nitrogen compounds, *Phosphorus compounds, *Nutrients, *Bioassay, *Runoff, *Lakes, *Impoundments, Tertiary treatment, Algae, Domestic wastes.
Identifiers: *Micronutrients, *Nutrient interactions, *Radiocarbon bioassay, *Nutrient types, Microquantities, Macroquantities, Algal blooms, Liebig's Law of the Minimum, Voisin's Law of the Maximum.

The purpose of the presentation is to provide a framework of reference on the eutrophication problems of freshwater. Important insights on eutrophication have come from the fields of botany, limnology, and sanitary engineering. Discussed are the types and impacts of critical nutrients. Special attention is focused on nitrogen, and phosphorus, including a detailed discussion of specific sources, namely rainfall, groundwater, forest runoff, agricultural runoff, urban drainage and wastewater effluents. Analysis is made of the relationship of nuisance conditions to nitrogen and phosphorus. Examination is made of the role of organic and inorganic micronutrients; the nature of nutrient interactions with various physical, chemical, and biological variables. Various approaches to control eutrophication are reported. Conclusions are reached that other than tertiary treatment, diversion of the nutrient-rich sources appears the most feasible eutrophication control. However, leaching or bacterial decomposition of nutrients from the sediments seems the limiting factor in lake recovery rates. Many processes in aquatic environments are attributed to bacteria, however, current analytical techniques are inadequate for the quantitative evaluation of bacterial species and number. (See W70-04761). (D'Arezzo-Texas)
W70-04765

BIOLOGICAL RESPONSES TO NUTRIENTS-EUTROPHICATION: SALINE WATER CONSIDERATIONS,
Texas Univ., Port Aransas. Inst. of Marine Science.
B. J. Copeland, and Donald E. Wohlschlag.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F. and Eckenfelder, W. W., Jr.), Austin, Texas, Univ of Texas Press, 1968. p 65-82, 8 fig, 2 tab, 41 ref.

Descriptors: *Zooplankton, *Ecosystems, *Marine microorganisms, *Sewage, *Wastewaters, *Photosynthesis, Nutrients, Phosphorus, Organic loading.
Identifiers: *Texas coast, *Species diversity, *Metabolic rates, Oil field brine-bleedwater, Petrochemical industry wastewaters, Seafood packing wastewaters, Pulp mill wastes.

This presentation examines and describes the major effects of the many nutrient-laden effluents on the estuaries, bays and lagoons along the Texas coast. It is found that the addition of a known nutrient source to a marine community resulted in changing ecosystem metabolic patterns. Increase in nutrient caused an increase in photosynthetic production. Species diversity of zooplankton is reduced in marine environments receiving some types of organic wastes indicating community disruption can result by new nutrient influxes. Toxic effects are not always detectable by conventional measurement methods. With a slight increase in mortality rate, the fish biomass affected would be decreased greatly. Experiments on fish metabolic rates showed that slight pollution stresses lower the metabolic rates greatly. The lowering was maximal when the fish were already subjected to an initial environmental stress, such as low temperature. Most of the effects of waste effluents on marine environments are subtle. It is believed that analyses based on the community rather than on the organismic approach are more practical in evaluating man-caused effects on inland saline ecosystems, even though the effects of stresses on individual populations can be physiologically quantifiable. (See W70-04761). (D'Arezzo-Texas)
W70-04766

ECOLOGICAL ASPECTS OF STREAM POLLUTION,
Texas Univ., Austin.
Neal E. Armstrong, and Earnest F. Gloyna.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F. and Eckenfelder, W. W., Jr.), Austin, Texas, Univ of Texas Press, 1968, p 83-95, 7 fig, 25 ref.

Descriptors: *Ecology, *Respiration, *Oxygen demand, *Ecosystems, *Model studies, *Stability, Plant growth, Energy, Design, Classification.
Identifiers: *Species-diversity index, *Diurnal curve, *Stream pollution, *Energy exchanges, *Gas exchanges, *Nutrient flows, *Energy-P/R relationship, Trophic levels, Organic transfer, Univ of Texas, Reaeration coefficient.

Two methods of evaluating the effects of pollution on the ecological system are presented, which furnish valuable information to the engineer regarding the condition and stability of ecological systems in receiving waters, and may ultimately become design criteria. Gases, nutrients and energy interchanges take place between components of the ecosystem. Gas exchange is related to plant and animal activities in photosynthesis and respiration; nutrient flows relate to the recycling processes and, energy integrates the ecosystem and can be described in thermodynamic terms. The species-diversity index method-the relation of individuals to species--has been used in comparing types of waters. The diurnal curve method has been used to find the total oxygen production and respiration in natural waters. Ecosystems may be classified according to oxygen production (P) and respiration (R) values and also their P/R ratios. Correlational analyses between energy stabilization and the P/R ratios afford significant insights into specific pollutional effects on ecosystem stability. Model studies at Univ of Texas are attempting to develop predictive curves for (P) and (R) against various waste parameters. (See W70-04761). (D'Arezzo-Texas)
W70-04767

ANALYSIS OF THE DISSOLVED OXYGEN VARIATION IN A FLOWING STREAM,
Manhattan Coll., Bronx, N.Y.
Donald J. O'Connor, and Dominic M. Di Toro.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F., and Eckenfelder, W. W., Jr.), Austin, Texas, Univ of Texas Press, 1968. p 96-102, 4 fig, 5 ref.

Descriptors: *Dissolved oxygen, *Continuity equation, *Reaeration, *Photosynthetic oxygen, *Natural streams, Variability, Aeration, Differential thermal analysis, Carbonates, Nitrogen compounds.
Identifiers: *Dissolved oxygen concentration, *Sources and sinks of oxygen, *Mass balance equation, *Natural aeration, *Artificial aeration, *Dissolved oxygen deficits, Fourier series expansion, Grand River, Lansing (Mich).

An analytical, mathematical example is presented which gives some insight into the complex relationships governing the oxygen balance in streams. The distribution of dissolved oxygen in a natural stream is definable by the continuity or mass balance equation in mathematical differential equation form. The equation describes temporal dissolved oxygen variation according to a spatial distribution along the axis of stream flow, and assumes a uniform concentration over the stream cross-section area. Both flow and cross-section area can be functions of space and time. The oxygen sources and sinks can be space, time and concentration functions. The concentration of dissolved oxygen is selected for this analysis. (However equation is applicable to any substance.) The sources of oxygen are the tributary inflows and brought about by natural or artificial aeration and by photosynthetic activity of green plants. The sinks of dissolved oxygen include biochemical oxidation of organic matter, use by benthal deposits and by aquatic plant respiration. Each of the above cited parameters are formulated into mathematical components of the continuity or mass balance equation. An illustrative analysis is made of the oxygen distribution in the Grand River near Lansing, Michigan. (See W70-04761). (D-'Arezzo-Texas)
W70-04768

RELATIONSHIP BETWEEN THE PHYSICAL AND BIOLOGICAL ENVIRONMENTS - PHYSICAL EXCHANGE,
Texas Univ., Austin; and Louisiana Polytechnic Inst., Ruston.
Frank D. Masch, and Joe R. Wilson.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F., and Eckenfelder, W. W., Jr.), Austin, Texas, Univ of Texas Press, 1968. p 103-110, 17 ref.

Descriptors: *Natural streams, *Diffusion, *Dispersion, *Turbulent flow, *Mathematical studies, *Eddies, *Pollution abatement, *Theoretical analysis, Flow characteristics, Estuaries, Reynolds Number.
Identifiers: *Fick's Laws of Diffusion, *Coefficient of diffusion, *Physical exchange, Assimilative capacity, Brownian motion, Molecular diffusion, Non-isotropic diffusivity, One-dimensional diffusion, Three-dimensional diffusion, Differential continuity equation, Prandtl's mixing length.

The efficient us of assimilative capacities of natural streams requires knowledge of the vital mixing, dispersion, diffusion and physical exchange processes. The term 'coefficient of dispersion' is normally used to describe the apparent diffusivity resulting from all mixing and exchange processes. A thorough theoretical analysis traces the mathematical expression of the process of diffusion from Fick's Laws of Diffusion through the analytical postulations of Prandtl based on the kinetic theory of gases, on to various empirical simplifications regarding shear flow mixing by subsequent investigators. Theoretical methods cannot always be based on a time-independent coefficient of dispersion Before any analytical solutions of the diffusion equation can be obtained, the dispersion coefficient must be known, assumed, or measured; and generalizations must be made for variations in stream and estuary velocity, cross-sectional areas, and the dimensionality of flow. In any event, these assumptions are complicated by the intrusion of numerous variables and the usual prevalence of non-uniform, unsteady turbulent flows. Nevertheless the joint use of mathematical analytical methods and sampling programs may serve useful planning purposes. (See W70-04761) (D'Arezzo-Texas)
W70-04769

MATHEMATICAL MODELING OF MIXING PHENOMENA IN RIVERS,
Boeing Co., Huntsville, Ala.; and Vanderbilt Univ., Nashville, Tenn.
James R. Hays, and Peter A. Krenkel.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F., and Eckenfelder, W. W., Jr.), Austin, Texas, Univ of Texas Press, 1968. p 111-123, 7 fig, 2 tab, 16 ref.

Descriptors: *Mathematical models, *Mixing, *Rivers, *Continuity equations, *Tracers, *Flow characteristics, *Laboratory tests, *Flumes, *Forecasting, *Mass trasfer, *Stagnant water, Flow rates.
Identifiers: *Turbulent flow, *Dead zone model, *Longitudinal mixing coefficients, Differential equations, Kalmogoroff's similarity principle, Concentration-time curves, Dispersed flow, Tennessee Valley Authority, Prediction.

Natural processes of waste dilution and purification in rivers, streams, lakes, and reservoirs are enhanced by natural mixing and dispersion. These phenomena require ample time and distance. Effective means of predicting the natural mixing and dispersion capabilities of receiving waters would enable better pollution control. Available field data usually indicates higher values when compared to mathematical models successfully tested in laboratory flumes. To ascertain the causes of this discrepancy, an analysis is made of the relevant mixing theories and empirical, numerical expressions including the continuity equations for turbulent flow and pipe flow methods for computing the longitudinal mixing coefficient using experimental data, hydraulic parameters, and Kolmogoroff's similarity principle. A so-called 'dead zone' model is proposed which takes into account stagnant areas, usually existing in receiving waters and the inadequacies of the one-dimensional representation of the mixing phenonemon are discussed. This model assumes that part of the tracer material injected in a river enters stagnant zones from which it emerges slowly. Model was tested in a laboratory flume and in several TVA rivers. Observed and predicted time-tracer concentration curves compared favorably. (See W70-04761). (D'Arezzo-Texas)
W70-04770

BIOLOGICAL AND PHYSICAL RESPONSES IN A FRESHWATER DISSOLVED OXYGEN MODEL,
Resources for the Future, Inc., Washington, D.C.; and California Univ., Berkeley.
Richard J. Frankel, and William W. Hansen.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F. and Eckenfelder, W. W., Jr.), Austin, Texas, Univ of Texas Press, 1968. p 126-140, 4 fig, 1 tab, 17 ref.

Descriptors: *Dissolved oxygen, *Model studies, Waste assimilative capacity, *Photosynthesis, *Respiration, *Oxygen demand, *Mathematical models, *Computer models, Mixing, Waste disposal, Oxygen sag, Sediments, Digital computers.

Identifiers: *Oxygen profile equations, Streeter-Phelps equation, *Stream quality, *Water quality, Case studyoFlint River-Lansing, (Mich), Management, Model applicability, Model sensitivity.

An expression has been developed to predict the spatial and temporal variations in dissolved oxygen concentrations in receiving natural waters. A case study, using digital computer methods, shows the validity of oxygen profile equations, provided proper inputs are used. Input data needed for complete use of the mathematical model showed that present stream survey practices do not afford enough data to describe the biological and physical responses in a stream. Data collection should be governed by sensitivity analysis namely, extent and oxygen demand of the sediments, biological extraction rate of attached organisms, and maximum rate of oxygen production (consumption) by photosynthesis (respiration). Diurnal fluctuations in waste loads, variations in reaction rates, and photosynthetic action in the stream have stronger effects on resulting conditions than generally believed. There is need for improving present predictive techniques used in evaluating pollution effects. (See W70-04761). (D'Arezzo-Texas)
W70-04771

RESEARCH DEVELOPMENTS IN REGARD TO CONCEPT AND BARE VALUES OF THE ACTIVATED SLUDGE SYSTEM,
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
Karl Wuhrmann.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F., and Eckenfelder, W. W., Jr.), Austin, Texas, Univ of Texas Press, 1968. p 143-170, 5 fig, 15 tab, 21 ref.

Descriptors: *Activated sludge, *Research and development, *Oxygen, *Growth rates, Bacteria, Photosynthetic bacteria, Photosynthesis, Respiration, Nitrification, Ammonia, Treatment facilities, Trickling filters, Fermentation, Assay.
Identifiers: *Excess sludge production, *Removal efficiencies, *Organic carbon, *Organic nitrogen, *Sludge-loss factor, Plant operation, Oxygen consumption, Sludge plants, Concept of continuous operation, Sludge loads.

The influence of hydraulic load, solids and oxygen concentration, and the temperature of the mixed liquor on the performance of the activated sludge process was investigated. A complete block factorial design experiment was conducted where the independent variables were tested at 3 levels temperature at 2 levels. A set of assays was evaluated on the basis of the theory of continuous fermentation in a completely mixed reactor. Studies were made of main actions and interactions of the independent variables on removal of organic carbon, organic nitrogen, BOD, and on production of excess sludge. Estimates are given of the gross yield factor in terms of organic carbon for calculation of excess sludge quantities. Growth rate of the bulk of sludge organisms is discussed. A causal formula is developed for finding the oxygen consumption in an aerator. Numerical values for endogenous and substrate respiration as function of plant operation parameters are presented based on experimental operations. There is a need for more reliable data on growth rates of sludge organisms and a better knowledge of the magnitude of the sludge loss factor under various conditions. (See W70-04761). (D'Arezzo-Texas)
W70-04772

CONCEPTIONS AND MISCONCEPTIONS IN BIOLOGICAL OXIDATION,
Rice Univ., Houston, Tex.
A. W. Busch.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F., and Eckenfelder, W. W., Jr.), Austin, Texas, Univ of Texas Press, 1968. p 171-175, 5 ref.

Descriptors: *Systems analysis, *Mathematical models, *Biological treatment, *Activated sludge, *Trickling filters, Nitrates, Nitrogen, Oxygen.
Identifiers: *Fluidized culture systems, *Biological oxidation, *Anaerobic systems, *Film-flow biological reactor, Warburg apparatus, Curve-fitting, Methane forming organisms.

Water technology is being pressed between concepts based on conventional, stereo-typed system design and new scientific knowledge. Two concepts derived from interdisciplinary activities are systems theory and mathematical models. As a result many misconceptions have arisen. Using examples in various facets of biological oxidation processes and concepts it is demonstrable that, generally, systems knowledge is more powerful than systems theory. Also, the equations of mathematical models and thermodynamic analysis must be descriptive before they can be used predictively. The following specific oxidational processes and concepts were analysed: (1) fluidized culture systems, (2) the use of nitrates as a source of 'chemical oxygen' in biological oxidation, (3) anaerobic systems which have assumed traditionally a two-stage sequence of biological reactions which exclude exogeneous hydrogen acceptors and depends on methane-forming organisms, and (4) the film-flow biological reactor. With respect to mathematical modeling the point is made that the model should serve as a description to work from rather than toward. And, in general, systems theory places serious overall limitations on processes; this is illustrated in specific cases regarding fluidized culture process. (See W70-04761). (D'Arezzo-Texas)
W70-04773

REMOVAL OF NITROGEN BY BIOLOGICAL TREATMENT,
Minnesota Univ., Minneapolis.
Walter K. Johnson.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F., and Eckenfelder, W. W., Jr.), Austin, Texas, univ of Texas Press, 1968. p 178-189, 4 fig, 2 tab, 38 ref.

Descriptors: *Biological treatment, *Nutrients, *Nitrification, *Denitrification, *Flow control, Nitrogen, Phosphorus, Wastewater treatment, Ecology, Eutrophication, Activated sludge, Trickling filters, Dissolved oxygen, Aeration, Control, Disposal, Incineration, Digestion.
Identifiers: *Nitrogen removal, *Wastewater effluent, Bioprecipitation processes, Stabilization ponds, Semiaerobic activated sludge process.

From data now known, it appears that reduction of nitrogen and phosphorus in wastewater plant effluents is vital in controlling eutrophication. However, other ecological factors may determine whether nitrogen or phosphorus, alone, limit algal growth in any given situation. Thus, the removal of solids and elements other than nutrient elements should not be neglected. Total solids removals may be necessary. Until higher degrees of removal are deemed necessary and economically feasible much can be done to increase the efficiency of nitrogen and phosphorus removal capabilities in plants and processes. Specific analyses and improvement suggestions are presented regarding: (1) the physical methods of removal, (2) bioprecipitation processes, (3) stabilization ponds, (4) nitrification and denitrification processes, and (5) nitrogen disposal. (See W70-04761). (D'Arezzo-Texas)
W70-04774

FACTORS TO BE CONSIDERED IN THE DESIGN OF ACTIVATED SLUDGE PLANTS,
Water Pollution Research Lab., Stevenage (England).
A. L. Downing.
Advances in Water Quality Improvements, (Editors: Gloyna, E. F., and Eckenfelder, W. W., Jr.), Austin, Texas, University of Texas Press, 1968. p 190-202, 8 fig, 14 ref.

Descriptors: *Design, *Activated sludge, *Aeration, *Oxidation, *Nitrification, Retention, Sewage, Ammonia, Temperature, Effluents.
Identifiers: *Longitudinal mixing, *Biological oxidation, *Loading, *Sludge settleability, *Sludge dewaterability, *Sludge production, Nitrified effluents, Carbonaceous matter, Biological oxygen demand, Retention period, Sewage retention, Carbonaceous oxidation.

To approach closer to optimization in the design of an activated sludge plant of required capacities more data is needed pertaining to the inter-relationships between operating variables and performance. Laboratory studies have revealed some ways of improving plant performance through design and operational changes. The effects of retention period and loading are examined in the specific areas of nitrified effluent production, carbonaceous matter removal, sludge production and sludge settleability and dewaterability. The degree of longitudinal mixing in aeration units with important effects heretofore seemingly neglected, are also examined. The status of knowledge on effects of mixing on biological oxidation, and the effects of mixing and concentration on the influence of inhibitory substances are analyzed. An assessment is made of the patterns, capacities, rates and efficiencies of aeration processes and methods. (See W70-04761). (D'Arezzo-Texas)
W70-04775

DEVELOPMENTS IN BIOLOGICAL FILTRATION,
Cornell Univ., Ithaca, N.Y.
Vaughn C. Behn, and Parviz Monadjemi.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F., and Eckenfelder, W. W., Jr.), Austin, Texas, Univerisity of Texas Press, 1968. p 204-214, 3 fig, 18 ref.

Descriptors: *Biological treatment, *Filtration, *Mathematical studies, *Trickling filters, *Mathematical models, Biochemical oxygen demand, Filters, Waste treatment, Flow characteristics, Design.
Identifiers: *Biological filtration, *Empirical models, *Recirculation filters, *Reaction kinetics, *Flow patterns, *High-rate trickling filters, Mass transfer coefficients, System design, Plug-flow, Mixed-flow.

A review is made of the major empirical and mathematical formulations for single-stage filters and recirculating filters and to define the process action of trickling filtration. Recirculation is an established fact with the operation of high rate trickling filters, affording uniformity and equalization of loadings, flexibility of plant operation and, beneficial seeding effects on plant influent. Some new concepts are presented concerning certain major factors which affect the performance of a biological treatment system. A continuous flow system includes some reactor (i.e., an activated sludge, a trickling filter or a sedimentation basin process) which has the function of reducing some undesirable property associated with the flow. The efficiency of such a system depends mainly on: (1) the type flow pattern of material passing through the system and, (2) the kinetics of the reaction itself. The effects of plug flow and completely mixed flow patterns on the efficiency of a system undergoing a first-order treatment reaction are described. The importance of bacterial concentration in most biological treatment systems regardless of the type of flow pattern is emphasized. Practical observations are made on the relationships of flow to bacterial concentration in determining the efficiency of trickling filter systems. (See W70-04761). (D-'Arezzo-Texas)
W70-04776

NEW CONCEPTS IN OXYGEN TRANSFER AND AERATION,
Texas Univ., Austin.
W. Wesley Eckenfelder, and Davis L. Ford.

Advances in Water Quality Improvement, (Editors: Gloyna, E. F., and Eckenfelder, W. W., Jr.), Austin, Texas, University of Texas Press, 1968. p 215-236, 14 fig, 3 tab, 27 ref.

Descriptors: *Aeration, *Oxygen, *Transfer, *Diffusion, *Mixing, *Surfactants, *Temperature, *Equations, *Design data, Mass transfer, Activated sludge, Equipment (Aeration), Bubbles (Aeration), Turbulence.
Identifiers: *Overall transfer coefficient, *Liquid film coefficient, *Mass transfer coefficients, *Oxygen transfer efficiency, Deoxygenated water, Steady-state aeration, Nonsteady state aeration, Mixing intensity, Surface active agents, Diffused aeration, Turbine aeration.

A general review is made of recent concepts in oxygen transfer and the practical data for design of aeration equipment is summarized. The theory and general development of the mechanism of oxygen transfer under quiescent and turbulent conditions are discussed. The most significant factors influencing the important overall transfer coefficient and the liquid film coefficient are temperature surface active agents in the liquid, and mixing intensity. Empirical mathematical expressions are presented for the temperature effect and for the film of excess surface concentration of surfactant molecules which serves as a barrier to diffusion. The effects of various mixing intensity ratios on oxygen transfer rates, under various aeration systems and flow regimes are shown graphically. The most commonly-accepted techniques used to determine aeration equipment performance efficiency and capabilities are: (1) nonsteady state aeration of deoxygenated water, (2) steady-state and nonsteady-state aeration of activated sludge, and (3) steady-state aeration of tap water. Aeration equipment used for sewage and industrial waste treatment consists of air diffusion units, turbine aeration systems in which air is released below the rotating blades of an impeller, and surface aeration units in which oxygen transfer occurs by virtue of high surface turbulence and liquid sprays. (See W70-04761). (D'Arezzo-Texas)
W70-04777

AERATION DEVELOPMENTS IN EUROPE,
Technische Hochschule, Vienna (Austria).
Wilhelm Von der Emde.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F., and Eckenfelder, W. W., Jr.), Austin, Texas, Univerisity of Texas Press, 1968. p 237-261, 23 fig, 1 plate.

Descriptors: *Aeration, *Diffusion, *Oxygenation, *Absorption, *Efficiencies, *Energy, *Sewage treatment, Bubbles, Design. Detergents, Baffles, Circulation, Design data.
Identifiers: *Danjes system, *Cone aeration, *Saran-tube aerator, *Brandol-tube aerator, *Plastic-box aerator, *Germany, Simplex cone, Oxygen absorption, Europe, Munich, Essen, Hamburg, Simcar cone, Vortair cone, BSK turbine, Mammut-Rotor.

Before the construction of large sewage treatment plants in Austria, investigations were made of major treatment facilities involving large scale aeration processes in Essen, Hamburg and Munich, Germany. The performance and economics of major aeration systems are discussed. The Essen plant tested the oxygenation efficiencies of Saran-tube, plastic box and Brandol-tube aerators under various arrangements as to location and bubble size. Results of the Danjes fine bubble aeration system at Munich are furnished. Results of widespread use of Simplex cone aeration throughout Europe are summarized. Major differences between the Simcar cone aeration system and the Vortair cone system are noted. Special operational and power requirements of the BSK Turbine aeration system is noted. Modifications to aerators and rotors leading to the development of the Mammut-Rotor are explained showing effects of immersion depth on absorbed energy aeration efficiency, and oxygen capacity. Comparisons are made with the Haworth paddle aeration system and the Kessener brush aeration system. (See W70-04761). (D'Arezzo-Texas)
W70-04778

MECHANISM OF INTERFERENCE OF SURFACE ACTIVE AGENTS IN AERATION SYSTEMS,
Michigan Univ., Ann Arbor; and Clemson Univ., S.C.
K. H. Mancy, and W. E. Barlage, Jr.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F., and Eckenfelder, W. W., Jr.), Austin, Texas, Univ of Texas Press 1968. p 262-286, 18 fig, 22 ref, 2 plates.

Descriptors: *Aeration, *Interfaces, *Surfactants, *Physicochemical properties, *Films, *Testing, Gases, Adsorption, Hydrodynamics, Mass transfer, Aerosols, Reynolds number, Mixing.
Identifiers: *Bubble aeration, *Stream aeration, *Surface aeration, *Liquid laminar jet system, *Gas transfer, *Surface active agents, Interfacial resistance, Dynamic surface tension, Dynamic surface concentration, Oxygen transfer coefficient.

Continued attention has been given to the effects of water soluble surface active agents, (SAA) on aeration processes. All experiments to date have encountered certain conflicting results which indicate that the presence of SAA in aeration systems may affect greatly the hydrodynamics of the air-water interface and, therefore, the rate of gas transfer. The physicochemical characteristics of the air-water interface have been examined closely in various systems including bubble aeration, stream aeration, surface aeration in stirred vessels, and liquid laminar jet systems. In comparing the results from these three different aeration systems, better understanding has been gained of the mechanism of interference of SAA on gas transfer. The degree of reduction of gas transfer rates caused by SAA in aeration systems depends on the hydrodynamics of the contactor and the chemical properties of the given SAA. There are two types of SAA interference with gas transfer, (depending on the structure and physicochemical properties of the SAA): (1) The SAA adsorbed film covers partially or totally the water surface, blocks dissolution sites at the interface, or distorts intermolecular forces between the gas molecule and the water surface necessary in the dissolution process. (2) The SAA increases the water surface viscosity, suppresses the interface hydrodynamic activity and, forms a viscous subsurface hydration layer. (See W70-04761). (D'Arezzo-Texas)
W70-04779

FLOCCULATION PHENOMENA IN BIOLOGICAL SYSTEMS,
Wisconsin Univ., Madison.
W. C. Boyle, K. Crabtree, E. P. Jaccarino, E. N. Lightfoot, and G. A. Rochlich.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F., and Eckenfelder, W. W., Jr.), Austin, Texas, Univ of Texas Press 1968. p 287-312, 2 fig, 4 tab, 60 ref, 4 plates.

Descriptors: *Flocculation, *Coagulation, *Activated sludge, *Bacteria, *Colloids, *Aggregates, Aeration, Hydrodynamics, Protozoa.
Identifiers: *Biological flocculation, *Rate of collision, *Collision frequency, *Biological systems, *Adhesive forces, *Disruptive forces, *Zoolgoea ramigera, *Bacterial flocculation, Polymerization, Agglomerations (Capsular, gelatinous matrix, protozoan).

There is a need for better understanding of the quantitative aspects of the biological flocculation process such as flocculation rates, size distributions, and effects of aggregates. Determination of these quantitative data requires actions to estimate floc collision rates, to evaluate the effectiveness of collisions and, to measure the relative adhesive and disruptive forces. The literature on colloid coagulation is reviewed to ascertain its usefulness and limitations. Current qualitative theories regarding cohesive forces are reviewed. The qualitative theory of floc formation for pure cultures of Zoogloea ramigera is discussed. Review of factors affecting the rate and size distribution of colloid aggregation is divided into three areas: (1) Population balances, (2) Prediction of collision frequency, which depends mainly on classical kinetic theory and hydrodynamics, (3) Description of disruptive forces, which are mainly hydrodynamic for bacterial flocs, and which tend to provide an upper limit for the size of primary aggregates. The categories of microbial aggregation concepts discussed are: (1) Capsular or gelatinous matrix agglomeration, (2) Colloidal hypotheses, (3) Protozoan agglomeration, (4) Inert matrix and salt-bridging hypotheses, (5) Low-energy concepts, and (6) Polymerization. (See W70-04761). (D'Arezzo-Texas)
W70-04780

INDUSTRIAL WASTE TREATMENT IN AERATED LAGOONS,
Hydroscience, Inc., Leonia, N.J.
John L. Mancini, and Edwin L. Barnhart.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F., and Eckenfelder, W. W., Jr.), Austin, Texas, Univ of Texas Press, 1968. p 313-324, 7 fig.

Descriptors: *Industrial wastes, *Waste treatment, *Aeration, *Activated sludge, *Data collections, *Laboratory tests, *Design, Activated sludge, Aerobic treatment, Digestion, Pilot plants, Temperature, Biochemical oxygen demand, Chemical oxygen demand, Suspended load, Economic impact.
Identifiers: *Aerated lagoons, *Low-solids production, *Suspended solids, *Aeration time, *Response function, *System constants and coefficients, *Laboratory data extrapolations, System response, BOD removal, Oxygen requirements, Numerical examples, Operating problems.

Data collection technique can be designed to establish a response function affording economic evaluation and alternative treatment options. A laboratory method is demonstrated which can be used to evaluate, compare, and design activated sludge, low solids production and aerated lagoon treatment systems from a single set of experimental data. The technique of handling activated sludge and aerated lagoon data in a continuous manner has proved effective in evaluating biological treatment systems. Performance predictions can be extrapolated from laboratory data for different waste strengths and aeration detention times. Technique permits determination of equilibrium solids in aerated lagoon systems and solids requiring handling and disposal in activated sludge systems. Methods of predicting aerated lagoon temperatures and performance have been illustrated. Pilot plant data can be studied to find or analyze: response functions for waste under question, ranges for coefficients and system constants, toxicity effects, sludge settling and separation, temperature effects and foaming problems. (See W70-04761). (D-'Arezzo-Texas)
W70-04781

NEW CONCEPTS IN AERATED LAGOON DESIGN AND OPERATION,
Metcalf and Eddy, Boston, Mass.
Clair N. Sawyer.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F., and Eckenfelder, W. W., Jr.), Austin, Texas, Univ of Texas Press, 1968. p 325-335, 7 fig, 7 ref.

Descriptors: *Aeration, *Design criteria, *Wastewater treatment, Aerobic conditions, Anaerobic conditions, Equipment (Aeration), Industrial wastes, Land, Activated sludge, Temperature, Biochemical oxygen demand (BOD), Treatment facilities.
Identifiers: *Aerated lagoons, *Mixed aerobic-anaerobic systems, *Aerobic systems, *Aerated

lagoon design, *Multiple aeration units, Heat loss, Temperature loss compensation, Detention time, Trickling filters, Activated sludge, Oxidation ponds, Stabilization ponds.

The aerated lagoon method of wastewater treatment provides economical high-degree treatment, with land requirements ranging from 1 to 10% of those needed for oxidation or stabilization ponds, and not larger than requirements for high-rate rock-type trickling filters. The further potentials and capabilities of the aerated lagoon method are examined in the light of currently improved knowledge of biological phenomena and other environmental factors. An analytic comparison is made of the mixed aerobic-anaerobic lagoon system versus the aerobic system; the choice in any given project requires careful engineering evaluation. Temperature considerations enter prominently in aerated lagoon system design in view of the excellent heat--dissipating properties afforded and the close relationship between BOD removal and temperature. The major advantage of the aerated lagoon over other methods of biological treatment is its great diluting capacity and ability to handle highly varied types of wastewaters. One of the major problems of design is the selection of aeration equipment. Generally, in large installations, mechanical-type aerators are favored over diffused air because of greater mixing potential and economy of installing electric lines versus air lines over large distances. The type of equipment to be selected depends heavily on whether the system being designed is based on the aerobic or aerobic-anerobic concept. (See W70-04761). (D-'Arezzo-Texas)
W70-04782

ANAEROBIC TREATMENT OF SOLUBLE WASTES,
Stanford Univ., Calif.
Perry L. McCarty.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F., and Eckenfelder, W. W., Jr.), Austin, Texas, Univ of Texas Press, 1968. p 336-352, 6 fig, 3 tab, 35 ref.

Descriptors: *Waste treatment, *Anaerobic conditions, *Design criteria, *Fermentation, *Methane bacteria, *Kinetics (Waste treatment), Bacteria, Biological treatment, Biological communities.
Identifiers: *Anaerobic waste treatment, *Soluble wastes, *Solid retention time (SRT), *Anaerobic process designs, *Anaerobic filter process, Microbiology, Biochemistry, Anaerobic activated sludge process, Anaerobic contact processes.

Anaerobic treatment of soluble wastes has the following advantages over aerobic treatment: (1) high loading rates with little production of biological solids for disposal, (2) lower power requirements, (3) useful production of methane as an end-product. Anaerobic contact processes have been developed, producing more rapid and efficient treatment, and enabling more economical treatment of relatively dilute wastes at ambient temperatures. Efficient anaerobic treatment of soluble wastes with BOD as low as 500 mg/l is now feasible. The best process for diluted waste treatment may be a two-stage operation: (1) anaerobic treatment for waste stabilization, (2) aerobic treatment for effluent polishing. The biological solids rentention time (SRT) is deemed the best parameter of anaerobic treatment control. A minimum SRT exists,-'a breaking point'-below which the critical methane-producing bacteria are removed faster than they can reproduce themselves. With very high SRT values, highly efficient treatment at lower temperatures can be obtained. The 'aerobic filter' appears one of the most promising contact processes for soluble waste treatment, permitting very high SRT's up to 100 days, and affords virtually all major benefits of anaerobic waste treatment process. (See W70-04761). (D'Arezzo-Texas)
W70-04783

NEW DEVELOPMENTS IN ANAEROBIC DIGESTION OF SLUDGES,
Texas Univ., Austin.
Joseph F. Malina, Jr., and Earnest M. Miholits.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F., and Eckenfelder, W. W., Jr.), Austin, Texas, Univ of Texas Press, 1968. p 355-379, 10 fig, 5 tab, 38 ref, 3 plates.

Descriptors: *Anaerobic conditions, *Digestion, *Sludge treatment, *Sludge disposal, *Sludges, *Chemical properties, *Solids contact processes, Chemical degradation, Organic compounds, Temperature, Mixing, Digestion tanks, Design criteria, Alkalinity.
Identifiers: *Biochemical reactions, *Anaerobic sludge digestion, *High-rate digestion, *Carter-Pearth gas recirculation systems, 'Shearfusers', Gaslifter digestion system, 'Bubble guns', 'Dynomix' system, 'Densludge' system, 'Aero-Hydraulic' system.

Primary and biological sludge treatment and disposal generated from wastewater treatment present more difficult problems than liquid waste treatment alone. The complexity of biochemical reactions involved in the liquefaction and gasification of wastewater sludges indicates vital need for external and internal control of the reaction variables. Optimum digestion requires solids mixing in a digestion tank by mechanical or gas recirculation methods, within the temperature range of 30 deg-35 deg C. The recommended volatile solids loading is 200 lb/1,000 cu.ft/day, with a detention time of from 10 to 15 days. Digester performance will be improved by maintaining the solids loading and hydraulic displacement as uniform as possible. The various chemical parameters characterizing the digester environment are sensitively interrelated. Therefore, for efficient digestion operations it is essential to determine and evaluate carefully the daily laboratory analyses of volatile acids, the alkalinity, the digestion sludge gases, pH, carbon dioxide production and other critical parameters of the particular wastes being treated. (See W70-04761). (D'Arezzo-Texas)
W70-04784

KINETICS OF BIOLOGICAL TREATMENT,
California Univ., Berkeley.
Erman A. Pearson.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F., and Eckenfelder, W. W., Jr.), Austin, Texas, Univ of Texas Press, 1968. p 381-393, 3 fig, 2 tab, 7 ref.

Descriptors: *Aeration, *Biological treatment, *Biological properties, Kinetics, Equations (Kinetics), Mathematical models, Oxygen demand, Effluents, Growth rates, Growth stages, Nutrients.
Identifiers: *Extended aeration, *Biological processes, *Michaelis-Menten growth model, *System kinetics, *Kinetic models, Organic substrate removal, Biological process constants, Nutrient removal.

A consistent and rational basis for a kinetic description of both aerobic and anaerobic waste treatment systems is presented. The kinetic model for growth and enzyme substrate removal is based upon that of Michaelis-Menten, and substrate and cell material balance equations including a decay term constitute the basic kinetic descriptions of the process. The need for further laboratory and field determinations of applicable kinetic constants is emphasized. A summary of currently known data on aerobic and anaerobic constants is furnished. The use of kinetic modeling in interpreting biological processes, such as extended aeration is demonstrated. An extended aeration plant is one where the net growth rate is made to approach zero; that is, growth is about equal to decay. An analytical approach to maximum growth processes for application in nutrient removal operations is presented. If aerobic and anaerobic treatment processes are to be evaluated for a specific waste treatment problem on a rational economic feasibility basis, the development of accurate kinetic constants for both processes is vital. (See W70-04761). (D-'Arezzo-Texas)
W70-04785

BASIS FOR WASTE STABILIZATION POND DESIGNS,
Texas Univ., Austin.
Earnest F. Gloyna.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F., and Eckenfelder, W. W., Jr.), Austin, Texas, Univ of Texas Press, 1968. p 397-408, 1 fig, 1 tab, 19 ref.

Descriptors: *Waste treatment, *Stabilization, *Ponds, *Design criteria, Facilities, Equations, Aerobic conditions, Anaerobic conditions, Algae, Algal control, Ecological distribution, Activated sludge, Maintenance costs, Construction costs.
Identifiers: *Waste stabilization ponds, *Algal physiology, *Design theory and calculations, Photosynthesis, Illumination, Temperature, Nutrients, Facultative pond designs, BOD, Sludge.

Many problems arising from use of waste stabilization ponds are traceable to inadequate engineering, poor maintenance and lack of operational supervision. However, there is a more fundamental need: Design and engineering for systems using stabilization ponds must be based on an understanding of the principles of algal physiology. Generally, algae growing in a stream or a waste stabilization pond are in a highly competitive environment. One or more of the factors necessary for photosynthesis are interrelated, and unicellular algae, in particular will react rapidly to environmental changes. Illumination, temperature, and nutrients--the factors which affect growth rate are examined critically. The phenomena of algal physiology, together with actual treatment objectives are synthesized in good design. In the final analysis, the specific design of a waste stabilization pond depends heavily upon the specifically-imposed treatment objectives and requirements. A pond system may be designed to receive untreated sewage or industrial wastes, primary or secondary treatment effluents or excess activated sludges and settleable solids. Certain critical factors in design development are discussed, based on operational experiences and research which provide vital insights into environmental factors governing waste stabilization processes. (See W70-04761) (D'Arezzo-Texas)
W70-04786

ADVANCES IN ANAEROBIC POND SYSTEMS DESIGN,
California Univ., Berkeley.
W. J. Oswald.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F., and Eckenfelder, W. W., Jr.), Austin, Texas, Univ of Texas Press, 1968. p 409-426, 6 fig, 2 tab, 11 ref.

Descriptors: *Waste treatment, *Stabilization, *Ponds, *Environmental effects, *Biological treatment, *Design criteria, Dissolved oxygen, Temperature, Biochemical Oxygen Demand (BOD), Evaporation, Fermentation, Methane, Algal control, Bacteria, Coliforms.
Identifiers: *Anaerobic waste ponds, *Depth effects, *Hydraulic load effects, *Organic load effects, *Detention time effects, *Faculative ponds, *Aerobic ponds, *Anaerobic ponds, Design for environmental control, Recirculation, BOD removal, Gas production.

The biological actions and interactions in waste stabilization ponds have been complex enough to deter scientific investigation and thus to foster the widespread use of empirical design formulations which are based on limited data. Recognition of the fact that sedimentation and four basic biological reactions interact in ponds, makes possible a rational design of ponds. Precise formulas have not yet been developed governing all variables. However, the relationships between temperature and methane fermentation, depth and temperature, and between depth and oxygenation are well-

established. Methane fermentation is the sine qua non for aerobic and facultative ponds; therefore, designs maximizing temperature uniformity and minimizing oxygen intrusion are most successful. In series ponds, which recycle oxygenated water, the prevention of odor in the initial anaerobic pond is done easily by overlaying the primary anaerobic pond with oxygenated water. For destruction of coliform bacteria, both time and temperature are vital factors. At normal pond temperatures, obtaining time increments by depth increases is easier than getting temperature increments by depth decreases. Wastes having high carbon/nitrogen ratios must be oxidized and aerated before fermentation. (See W70-04761). (D'Arezzo-Texas)
W70-04787

WASTE STABILIZATION POND PRACTICES IN THE UNITED STATES,
Federal Water Pollution Control Administration, Dallas, Tex.
Jerome H. Svore.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F., and Eckenfelder, W. W., Jr.), Austin, Texas, Univ of Texas Press, 1968. p 427-434, 2 fig, 2 tab, 8 ref, 1 plate.

Descriptors: *Stabilization, *Ponds, *Design, *Efficiencies, *Chlorination, *Odor, *Waste treatment, Algae, Disinfection, Biochemical Oxygen Demand (BOD), Aeration, Coliforms, Algal control, Dissolved oxygen.
Identifiers: *Aerated lagoons, *Midwest (US), *Southwest (US), *Design criteria, Pond effluent, Colorado, West (US), Stabilization pond loadings, Odor persistence.

The design, operations, and gradual acceptance of waste stabilization ponds in the Southwest during the past 25 years is traced. Recent surveys in Colorado have substantiated general experience in the Midwest, classifying the predominant defects in design, construction, and operation into three classes: (a) liquid depth not maintained, (b) water surface inadequate, and (c) primary solids not evenly distributed. A comparison is made of current methods used throughout the southern half of the United States regarding the excessive algae problem. The determination of lagoon treatment efficiency must be made from the viewpoint of regional water priorities and objectives. The reduction in required chlorine disinfection usage resulting from efficient pond operation is discussed. Some reasons for the trend toward greater use of aerated lagoons are presented. While there are still isolated areas where opinion exists that waste stabilization ponds are dangerous, undesirable and, a health hazard, the major trend is toward recognition that if ponds are designed and operated properly (in series), they will provide more treatment per unit cost than any other single process. (See W70-04761). (D'Arezzo-Texas)
W70-04788

WASTE STABILIZATION POND PRACTICES IN CANADA,
Waterloo Univ. (Ontario).
Charles P. Fisher, W. R. Drynan, and G. L. Van Fleet.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F., and Eckenfelder, W. W., Jr.), Austin, Texas, Univ of Texas Press, 1968. p 435-449, 2 fig, 1 tab, 21 ref.

Descriptors: *Stabilization, *Ponds, *Sewage treatment, *Design criteria, *Climatic zones, *Efficiencies, *Odors, Wastewater treatment, Coliforms, Operations.
Identifiers: *Canada, *Prairie provinces, *Northwest territories, *Climatic conditions, Multiple pond requirements, Loading rates.

The waste stabilization pond form of wastewater treatment is gaining acceptance in Canada. The trend is to use this treatment for domestic wastes from large cities. Generally, the efficiency is affected significantly by climatic conditions. Summertime BOD5 removal efficiencies vary between 65% and 90%; winter efficiencies vary between 0% and 55%. Coliform reduction exceeding 99% has been achieved within some ponds. Waste stabilization ponds in the Prairie provinces and in the Northwest Territories, where there are severe winters, are designed for complete winter storage. Elsewhere in Canada ponds are generally continually discharging. Waste stabilization pond treatment systems, consisting of short detention (anaerobic) ponds in series with long detention (facultative) ponds, are also gaining acceptance in the Prairie provinces. Pond organic loading rates vary generally between 10 and 45 lbs. BOD5/acre/day. Odors are commonly associated with the break-up of ice during the springtime on ponds in the Prairie provinces. (See W70-04761). (D'Arezzo-Texas)
W70-04789

EXTRA-DEEP PONDS,
Technion - Israel Inst. of Tech., Haifa; and Water Planning for Israel Ltd., Tel Aviv.
Alberto M. Wachs, and Andre Berend.
Advances in Water Quality Improvement, (Editors Gloyna, E. F., and Eckenfelder, W. W., Jr.), Austin, Texas, Univ of Texas Press, 1968. p 450-456, 5 fig, 1 tab, 9 ref.

Descriptors: *Ponds, *Stabilization, *Thermal stratification, *Seasonal, *Sulfides, Temperature, Climatic data, Stratification, Dissolved oxygen, Algae, Biochemical Oxygen Demand (BOD), Mixing, Winds.
Identifiers: *Thermal gradient, *BOD removal, *Israel, *Algal concentration, 'Extra-deep ponds', Ashkelon (Israel), Temperature profiles, Volatile suspended solids, Multi-cell serial system, pH, Facultative pond, Anaerobic pond.

An experimental unit was built by Tahal, Ltd, near the wastewater treatment facility, Ashkelon, Israel, to obtain pilot plant performance data on 'extra-deep' waste stabilization ponds, (i.e., depth greater than 8 feet). The experience gained shows that when loadings acceptable to the Israel climate were used during the warm season, a pronounced thermal gradient caused the upper part of the pond to behave as a 'separate' facultative pond 'floating' on an underlying anaerobic pond. This stratification was enhanced by the fact that both inlet and outlet were located at the surface. Effluent was rich in algae. During the warm season, algal concentrations were much lower at or below depths of 1 meter; therefore, placing of outlet at that depth would draw off better effluent insofar as algal density was concerned, but it was deficient in dissolved oxygen at times. The thermal gradient disappeared during the cold season. Mixing was due mainly to wind action and influenced by pond geometry. Dissolved oxygen was not always present in the upper pond layers but it did contain considerable algae. During fall, a pond turnover occurred resulting in mixing of lower and upper layers. This caused a surface increase of sulfides concentration, a drop in pH, but no odors. During both cold and warm seasons, BOD removal was about 80%. (See W70-04761). (D'Arezzo-Texas)
W70-04790

WASTE STABILIZATION PONDS FOR AGRICULTURAL WASTES,
California Univ., Davis; and Kansas State Univ., Manhattan.
Samuel A. Hart, and Marvin E. Turnet.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F., and Eckenfelder, W. W., Jr.), Austin, Texas, Univ of Texas Press, 1968. p 457-463, 2 tab, 6 ref.

Descriptors: *Waste treatment, *Stabilization, *Ponds, *Design criteria, *Anaerobic digestion, Sludge, Disposal, Odors, Mosquitoes, Insect control, Subsurface waters, Infiltration, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD).
Identifiers: *Agricultural wastes, *Manure stabilization pond, *Livestock manure characteristics, *Pond loading rates, *Pond appearance and location, Sludge digestion, Sludge disposal

In contrast to sewage and other wastewater stabilization ponds, manure disposal ponds are expected to accept very large amounts of organic solid matter, often with scarcely enough water to get the wastes into the pond. The objective is stabilization and disposal of organic matter rather than water purification; effluent is lacking; make-up water is often needed. Biochemical oxygen demand (BOD) loading ranges up to 1200 lbs/acre/day; anaerobic conditions predominate; and are functionally comparable to open unheated sludge lagoons or conventional sludge digesters. Research during the past 5 years confirms dependence on anaerobic processes to stabilize agricultural wastes. Major design criteria are: (1) control odors, (2) control fly and mosquito production, (3) prevent infiltration of pond liquor to subsurface natural waters, (4) proper siting for aesthetic purposes. Other important design considerations relate to: volume and depth criteria, summer sludge upwelling requirements and winter sludge submersion requirements, manure inlet location, sludge build-up rates and removal, pond water levels, effluent runoff control, pond geometry and, plant and insect control. (See W70-04761). (D'Arezzo-Texas)
W70-04791

STABILIZATION PONDS IN THE CANNING INDUSTRY,
Federal Water Pollution Control Administration, Washington, D.C.
Robert A. Canham.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F., and Eckenfelder, W. W., Jr.), Austin, Texas, Univ of Texas Press, 1968. p 464-476, 2 fig, 2 tab, 25 ref.

Descriptors: *Stabilization, *Ponds, *Solid wastes, *Separation techniques, *Lagoons, *Odors, Efficiencies, Costs, Design standards, Land, Aeration, Bioindicators, Oxygen demand, Enzymes, Anaerobic digestion.
Identifiers: *Canning industry, *Canning waste, *Sodium nitrates, Odor masking agents, Pure or selected cultures, Biocatalyst additives, Anaerobic-aerobic lagoon treatment, Aerated lagoon, National Canners Association.

The canning industry began at the turn of this century to use the lagoon method for waste treatment. However, the industry regarded this method as disposal rather than treatment, and generally this philosophy still prevails. Early lagoons served essentially as absorption areas providing for wastewater infiltration into subsurface waters, subject to the vagaries of soil conditions and waste properties. Later lagoon types served mainly as seasonal waste storage areas. Increasing odor problems led to widespread practice of using sodium nitrate, but results were unsuccessful due to the cost of nitrates and the consequent reduction in quantities used. Lagoon use declined, as other land methods, such as spray irrigation, were introduced. The combination aerobic-anaerobic system was studied, found effective for treatment, but the odor problem remains. The following methods were tested but found inadequate: innoculations with pure cultures, odor masking agents, biocatalyst additives such as enzymes, and aerated lagoons. Operational variations were tried, but the odor problem remained. A more realistic lagoon design and cost approach is essential to make the lagoon method effective for the canning industry. This means greater cost, more land, more chemicals or aeration. (See W70-04761). (D'Arezzo-Texas)
W70-04792

WASTE TREATMENT IN THE MEAT PROCESSING INDUSTRY,
Carter (Ralph B.) Co., Hackensack, N.J.
A. J. Steffen.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F., and Eckenfelder, W. W., Jr.), Austin, Texas, Univ of Texas Press, 1968. p 477-491, 5 fig, 2 tab, 1 pl, 21 ref.

Descriptors: *Waste treatment, *History (Meat processing wastes), *Disposal, *Stabilization, *Pre-treatment (Wastes), *Odors, Anaerobic digestion, Lagoons, Tertiary treatment, Pilot plant, Biochemical Oxygen Demand.
Identifiers: *Meat processing industry, *Waste conservation, *By-product recovery, *Disposal by irrigation, *Stabilization basins or lagoons, *Anaerobic ponds (Pre-treatment), *Modified anaerobic contact process, Aerobic ponds (Complete treatment), Tertiary ponds.

Chemical treatment evoked interest 20-30 years ago, is now limited to pre-treatment achieving only 50-70% BOD removal in current, optimally designed and operated plants. Aerobic treatment such as washable trickling filters have been successful; activated sludge treatment has been effective, but requiring pre-treatment to reduce BOD; aeration systems in concrete tanks and lagoons have been effective for poultry waste treatment; irrigation has been effective for raw meat packing wastes disposal (Illinois and New Zealand) but overall impacts on soil, crops and livestock disease transmission need closer study. Anaerobic ponds are effective as 'roughing' ponds for meat packing wastes because wastes are warm, have high BOD, high organic solid content, and provide proper nutrient balance. Combination aerobic and anaerobic ponds have proved effective. The anaerobic contact process can remove 90-96% BOD in a waste of 1400 mg/l at a digester loading of 0.16 lbs/day/cu. ft, with equalized flow. Digester is a completely mixed system; mixed liquor is degasified by vacuum before gravity separation of sludge which is recirculated to digesters at ratios of 3:1 or 4:1. Process can be closed down on weekends or extended periods without loss of treatment efficiency. By aerobic pond polishing, BOD removal of 80% and suspended solid removal of 88% can be achieved. (See W70-04761). (D-'Arezzo-Texas)
W70-04793

WASTE STABILIZATION POND PRACTICES IN THE PULP AND PAPER INDUSTRY,
Johns Hopkins Univ., Baltimore, Md.; and Louisiana State Univ., Baton Rouge.
Isaiah Gellman, and Herbert F. Berger.
Advances in Water Quality Improvement, (Editors: Gloyna, E. F., and Eckenfelder, W. W., Jr.), Austin, Texas, Univ of Texas Press, 1968. p 492-496, 1 fig, 3 tab, 7 ref.

Descriptors: *Stabilization, *Waste treatment, *Ponds, *Aeration, *Design, *Biochemical Oxygen Demand (BOD), *Odors, Efficiencies, Costs, Construction, Mills, Pilot plants, Retention.
Identifiers: *Waste stabilization ponds, *BOD removal, *BOD loading, *Aerated stabilization ponds, *Pulp and paper industry, Laboratory tests, National Council for Stream Improvement, High-degree effluent treatment, Kraft mills, Chip board mills.

The stabilization pond technique is used predominantly for pulp and paper mill effluents. Data from Southern kraft mill operations indicate that pond design loadings of about 50 lbs of BOD5/acre/day enable at least 85% BOD removal; loadings below 50 lbs provide BOD removals exceeding 90%; increased loadings result in a levelling-off of BOD removals ranging from 60 to 70 lbs/acre/day. Higher BOD removals (up to 150 lbs/acre/day) can be attained using multiple-pond systems; however, high removal operations are accompanied by anaerobic odor production, emission of sulfides, and sulfide oxidizing bacteria. Laboratory and pilot plant studies of aerated stabilization basin process by the National Council for Stream Improvement and its member mills have led to rapid acceptance and extensive application. The aerated basins can remove 40-60 lbs BOD/acre/day, without anaerobic odor production; this correlates well with natural reaeration rates for shallow basins. Construction and operating costs for aerated stabilization pond treatment are about 60% and 40%, respectively, of activated sludge treatment, in the 90% BOD removal range. (See W70-04761). (D-'Arezzo-Texas)
W70-04794

TREATMENT STUDIES OF COMBINED TEXTILE AND DOMESTIC WASTES,
Purdue Univ., Lafayette, Ind.
For primary bibliographic entry see Field 05A.
W70-04795

'BALAS' ALGORITHM FOR ZONED UNIFORM TREATMENT,
Johns Hopkins Univ., Baltimore, Md.
Jon C. Liebman, and David H. Marks.
Journal of the Sanitary Engineering Division, American Society of Civil Engineers, Vol 94, No SA4, Proc Paper 6059, August 1968. p 585-593, 1 fig, 2 tab, 12 ref.

Descriptors: *Mathematical models, *Optimization, *Cost comparisons, *Pollution abatement, *Water quality control, *Water management, *Treatment, Cost analysis, Treatment facilities.
Identifiers: *'Balas' algorithm, *'Zoned uniform treatment', Cost minimization, Delaware Estuary, BOD removal, Uniform treatment, Fortran IV, IBM 7094 computer.

The basic objective of water-quality management is to find the solution to a pollution abatement problem that achieves a specified quality condition in the watercourse in a legally equitable and economically efficient manner. This problem has been approached in various ways; (1) uniform-treatment schemes in which all discharges into streams are given equal treatment; (2) cost-minimization schemes in which mathematical optimization methods are used to achieve desired quality at minimum treatment costs. Optimization schemes have been resisted because they involve individual local inequities in treatment of discharges even though from a regional viewpoint, quality standards and costs are optimal. A compromise concept called, 'zoned uniform,' is suggested. Concept is based on classifying waste discharges into 'uniform zones' (both geographical and categorical in nature) with each waste source given similar treatment to that of similar sources. Total cost is then minimized as long as treatment level is maintained in each zone. An enumeration scheme solution is presented using Delaware Estuary data. (D'Arezzo-Texas)
W70-04796

PERFORMANCE OF PLASTIC FILTER MEDIA IN INDUSTRIAL AND DOMESTIC WASTE TREATMENT,
Imperial Chemical Industries Ltd., Brixham (England).
P. N. J. Chipperfield.
Journal Water Pollution Control Federation, Vol. 39, p1860-1874, 1967.

Descriptors: Industrial wastes.
Identifiers: *Polyvinyl chloride, *Biological filters, *Textile mill wastes, Dyeing, Fabric finishing.

A plastic filter packing made from polyvinyl chloride was found to be useful as biological filter material in disposal plants handling domestic and industrial wastes, including those from textile mill dyeing and finishing operations. (Work-North Carolina State Univ)
W70-04797

KINETICS OF ADSORPTION BY ACTIVATED CARBON FROM DILUTE AQUEOUS SOLUTION,
National Institutes of Health, Bethesda, Md.; and Maryland Univ., College Park.
Robert L. Dedrick, and Robert B. Beckmann.
Chemical Engineering Progress Symposium Series No 74, (Physical Adsorption Processes and Principles), Vol 63, 1967. p 68-78, 10 fig, 4 tab, 37 ref.

Descriptors: *Activated carbon, *Adsorption, *Diffusion, *Kinetics, Equilibrium, Isotherms.
Identifiers: *Advanced waste treatment, *Dichlorophenoxyacetic acid, *'Homogeneous diffusion model', *'Pore diffusion model', Concentration, Diffusivity, Intraparticle diffusion.

The removal of small concentrations of dissolved substances from liquids by processes using activated carbon continues to have broad and increasing importance. This study stems from the premise that despite the long history of carbon application, knowledge of kinetics and mechanism of adsorption from liquid solution are incomplete. The two basic mathematical models of intraparticle diffusion kinetics are analyzed: (1) homogeneous diffusion model, (2) pore diffusion model. Tests were made of adsorption of 2-4 dichlorophenoxyacetic acid from dilute solution on carbon such that the rate of transport in the absorbent was controlling, and direct microanalysis of absorbent was made. Authors consider that both models are limiting cases lacking exact precise description of intraparticle diffusion mechanism. The probable mechanism appears to involve both migration of absorbate through the porous carbon with a high energy of activation and diffusion in the adsorbent pores. Surface migration of the homogeneous model appears superimposed on irreversible pore diffusion model effects. (D'Arezzo-Texas)
W70-04798

THE PREVENTION OF WATER POLLUTION WITH SPECIAL REFERENCE TO SOME ASPECTS OF THE TEXTILE INDUSTRY,
Canadian Industries Ltd., Montreal (Quebec).
N. E. Cooke.
Canadian Textile Journal, Vol. 81, p39-44, 1964.

Descriptors: *Water pollution, Water quality.
Identifiers: *Textile mill wastes, *Rayon, *Wool, Sizing, Dyeing, Bleaching.

Tables describe the water quality criteria for (1) drinking water, (2) manufacture of viscose rayon, (3) textile manufacture, (4) support of fish and (5) the objectives of the International Joint Commission for Boundry Waters Quality Control. The sources of biological oxygen demand load in textile mill effluents are (1) impurities in the fibers, (2) sizing and other agents needed for weaving, (3) scouring agents, (4) agents for dyeing, bleaching, and printing, and (5) finishing agents. A table presents the ranges of the five classes as related to the processing of natural and man-made fibers. A second table gives details based on two methods of processing wool, showing that a solvent-based process reduces the biological oxygen demand of the waste to one-ninth of that using the traditional wet scour. Generally accepted methods of treating textile mill wastes are reviewed. The principles used in preventing water pollution by the Millhaven, Ontario and Dalhousie, N.B., plants of Canadian Industries, Ltd., and one example of pollution and aeration from the latter are described. (Work-North Carolina State Univ)
W70-04799

LOW TEMPERATURE ACTIVATED SLUDGE SETTLING,
Alaska Univ., College.
Sherwood C. Reed, and R. Sage Murphy.
Journal of the Sanitary Engineering Division, American Society Civil Engineering, Vol 95, No SA4, Proc Paper 6747, August 1969. p 747-767, 13 fig, 5 tab, 21 ref.

Descriptors: *Activated sludge, *Settling velocity, *Temperature, *Design, Sewage treatment.
Identifiers: *'Zone-settling', *Activated sludge particle, *Sludge-blanket clarifiers, *Thermal protection, *Sludge, Concentration, Particles, Clarification, Fairbanks (Alas), Stokes' Law, BOD.

This investigation is concerned with the temperature influence upon activated sludge sedimentation theory. Particular attention is focused on temperature effects on 'zone' settling velocity. The study is generated by research results in Alaska on aerated

lagoons and sludge processes which indicated apparent high efficiencies requiring minimal thermal protection. Thus, basically conventional treatment plant designs might be economically adaptable to cold weather regions without costly systems thermal protection. This study presents results of a series of settling tests using temperature and concentration as controlled variables. An empirical equation was developed defining the variations of zone settling velocity of activated sludge in terms of concentration, fluid temperature, and organic loading. Temperature effects diminish with increasing concentration. Equation affords rational basis for analysis of design requirements for cold region treatment facilities. Study concludes tentatively that the compression, or thickening, of sludge is independent of fluid temperature. (D'Arezzo-Texas)
W70-04800

LIME CLARIFICATION, RECOVERY, REUSE, AND SLUDGE DEWATERING CHARACTERISTICS,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Cincinnati Water Research Lab.
M. C. Mulbarger, E. Grossman, III, R. B. Dean, and O. L. Grant.
Journal Water Pollution Control Federation, Vol 41, No 12, p 2070-2085, December 1969. 11 fig, 5 tab, 28 ref, sample calculations.

Descriptors: *Activated sludge, *Dewatering, *Flocculation, *Lime, Phosphorus, Sludge treatment, Wastewater treatment, Slaking.
Identifiers: *Calcination, *Clarification, *Lime reuse, *Lime recovery, *Secondary effluent, *Experimental system, Recarbonation, Thickening, Vacuum filtration.

This investigation, using typical biologically-stabilized effluents, focuses on studying: (1) the effect of wastewater quality on unit process performance; (2) the possible variations of sludge characteristics as functions of the wastewater treatment system; (3) effects of multiple lime reuse on process performance and calcined sludge quality; (4) possible prediction of required lime makeup and sludge wastage rate before start of operations; (5) possible improvement of lime sludge dewatering properties by addition of flocculants. Specifically, a 75-1 day batch system was used to find effects of secondary effluents and the clarification system on: (1) lime dose; (2) clarification effectiveness; (3) sludge thickening; (4) dewatering characteristics; (5) recalcined sludge quantity and quality. Investigation found that lime reuse did not affect removal efficiency, reuse affected sludge thickening slightly but increased greatly dewatered sludge cake yields. Secondary effluent properties greatly affect system performance and lime sludge characteristics. Sludges produced from mineralized waters having low ratios of magnesium hydroxide/calcium carbonate have superior dewatering properties. Of the four additive flocculants studied, a nonionic flocculant proved most effective; the point of addition affected only slightly the sludge filterability. (D-'Arezzo-Texas)
W70-04801

DEFINED VELOCITY GRADIENT MODEL FLOCCULATOR,
University Coll., London (England).
Francois A. Van Duuren.
Journal of the Sanitary Engineering Division, American Society of Civil Engineers, Vol 94, No SA4, Proc Paper 6076, August 1968. p 671-682, 8 fig, 12 ref.

Descriptors: *Flocculation, *Shear flow, *Laminar flow, Sedimentation, Suspension, Design criteria, Mathematical studies, Bacteria, Hydraulics, Diffusion
Identifiers: *Flocculator, *Velocity gradient, Coaxial cylinders, Ritchie device, Annulus two-dimensional flow, Flow stability, Centripetal acceleration, Theoretical analysis, Design desiderata, Synchronous electric motor, Couette model flocculator.

Orthokinetic flocculation is the most important engineering process in the removal from water of mineral and biological particles up to the size of bacteria. Flocculation is effected by the collision of particles which occurs when velocity gradients exist within a flow. Hence, the study of flocculation requires devices for which shear in the flow can be determined. With this objective, design criteria are outlined and the theoretical basis given for a velocity gradient flocculator. A coaxial cylinder horizontally-mounted, couette device developed is described. The advantage of horizontal mounting of cylinders is to limit sedimentation. This flocculator can be used to apply a desired velocity gradient to particle suspension in order to study various aspects of flocculation. Device behaves properly hydraulically in that it results in a predominantly two-dimensional flow for a wide range of particle coagulant concentrations. The floc-flow patterns observed in flocculation tests with quartzite particles and alum are described. (Shankar-Texas)
W70-04802

PILOT INVESTIGATION OF STARCH-GLUTEN WASTE TREATMENT,
Purdue Univ., Lafayette, Inc.
Joseph T. Ling.
Purdue University, Engineering Bulletin, Extension Series No. 109, p.217-231, 1962.

Descriptors: *Anaerobic digestion, *Lagoons, Solid wastes, Biochemical Oxygen Demand.
Identifiers: *Starch-gluten waste, *Starch-gluten waste treatment, Waste analysis, Protein waste, Starch waste, Carboyhydrate waste, Seeding.

The principal waste involved had a five-day BOD of 12,000 parts per million, consisting of 800 parts per million suspended solids and 15,000 parts per million total solids, of which 14 percent was protein, 7 percent starch, and 79 percent carbohydrate. Of the carbohydrates, 62 percent was reducing sugar. A pilot scale anaerobic digestor was tested during a three-week period. Eighty percent removal of volatile solids was accomplished at a loading of 0.1 lbs. volatile/cu.ft. digestor vol./day. The maximum allowable loading was not reached. Anaerobic lagooning was simulated in 55-gal. drums, and was successful if seeding was included. A minimum of 50 percent removal of volatile solids was observed in seeded lagoons when they were operated at 32-43 deg F. for 11 weeks. The loading applied to the lagoons was 0.022 lbs. volatile solids/cu. ft/day. No objectionable odor was observed in the seeded lagoons within four weeks. Settling of the wastes for 2.5 hrs. was most economical, and this by itself removed 35 percent of the suspended solids. (Livengood-Mattox-North Carolina State Univ)
W70-04803

AMMONIA REMOVAL FROM SECONDARY EFFLUENTS BY SELECTIVE ION EXCHANGE,
Battelle Memorial Inst., Richland, Wash.; and Federal Water Pollution Control Administration, Cincinnati, Ohio.
B. W. Mercer, L. L. Ames, C. J. Touhill, W. J. Van Slyke, and R. B. Dean.
Journal Water Pollution Control Federation, Vol 42, No 2, p R95-R107, Feb 1970. 10 fig, 1 tab, 16 ref.

Descriptors: *Ammonia, *Ion exchange, Resins, *Nitrogen, *Separation techniques, Nitrogen compounds, Effluents, Filtration, Zeolites.
Identifiers: *Clinoptilolite, *Laboratory-scale studies, *Nitrogen inorganic compounds, *Pilot-plant studies, Secondary effluents, Regeneration (Engineering), Removal, Elution curves, Zeolite regeneration process, Mobile demonstration plant.

Removal of ammonia from secondary effluent was demonstrated on a laboratory and pilot scale with a selective ion exchange process. Process uses a natural zeiolite, clinoptilolite, which is selective for ammonium ions in the presence of sodium, magnesium and calcium ions. Regeneration is done with lime solutions, providing hydroxyl ions which react with ammonium ions to yield an alkaline aqueous ammonia solution. The solution is processed through an airstripping tower to remove the ammonia. Spent regenerant is fortified with more lime and recycled. The process does not generate liquid wastes. One cubic foot of granular clinoptilolite regenerated with lime can remove ammonia from more than 2,000 gallons of secondary effluent. Ammonia removals of over 99% were obtained for two columns in series during laboratory experiments. A mobile demonstration plant with a 100,000 gallon per day capacity was constructed. (D'Arezzo-Texas)
W70-04804

INVESTIGATION OF A WOOD CURING WASTE,
San Jose State Coll., Calif.
Vernon L. Stump, and Franklin J. Agardy.
Journal of the Sanitary Engineering Division, American Society of Civil Engineers, Vol 95, No SA6, Proc Paper 6953, Dec 1969. p 1051-1061, 6 fig, 14 ref.

Descriptors: *Wood-wastes, *Thermo-dri-process, *Industrial wastes, *Wood preservatives, Chemical oxygen demand, Coagulation, Biochemical oxygen demand, Toxicity, Colloids.
Identifiers: *Vacuum chamber, *Oil separator, *Flotation, Reactor unit, Oxidation ponds, Neutralization, Potential biodegradability.

The investigation of the characteristics of a waste produced by an industry should be carried out prior to or, concurrently with, the design and construction of the waste producing facility. Laboratory studies have been made to determine the characteristics and biological treatability of an industrial waste resulting from a new rapid wood curing process referred to as the Thermo-dri-process. Similarly to most wood preserving wastes, there is a much larger chemical oxygen demand (7500 mg/l) than biochemical oxygen demand (2260 mg/l) for the waste associated with the new wood curing process. The BOD/COD ratio is very low with a value of 0.30. The BOD rate constant of the raw waste to the base e is found to be 0.105, indicating poor biodegradability. The organic fraction of the waste is associated mostly with the suspended colloidal matter of the waste, (90%). The BOD determination is difficult and is affected by the size of the sample. The manometric techniques give a more reliable value. Toxicity studies indicate that the waste has a toxic effect as its concentration with respect to bacterial seed increases. Nutrient studies indicate the need for supplementary nutrients such as nitrogen and phosphorus for optimum biological treatment. (Shankar-Texas)
W70-04805

PHOSPHORUS REMOVAL FROM WASTEWATER BY DIRECT DOSING OF ALUMINATE TO A TRICKLING FILTER,
Federal Water Pollution Control Administration, Cincinnati, Ohio.
E. F. Barth, B. N. Jackson, R. F. Lewis, and R. C. Brenner.
Journal Water Pollution Control Federation, Vol 42, No 11, p 1932-1942, Nov 1969. 6 fig, 9 tab, 5 ref.

Descriptors: *Phosphorus, *Trickling filters, *Efficiencies, *Analytical techniques, *Aluminum, *Nitrogen, Wastewater treatment, Filters (Rock), Suspended load, Effluents.
Identifiers: *Operations, *Aluminates, *Chemical removal, *Wastewater characteristics, Secondary sludge, Volatile content, Primary sludge, Digester gas production, Digester supernatant, Dosages, Trickling filter plant.

Trickling filters containing rock media can be dosed with sodium aluminate to increase phosphorus removal efficiency. Filter operation or biological slime on rock media was not affected adversely. Efficiency of the dosed filter for COD, suspended solids and nitrogen removal was similar to that of the control filter. Direct dosing of rock

mineral supplement is not as efficient for phosphorus removal as adding minerals to an activated aeration chamber. Rock media filters short circuit primary effluents without efficient film surface contact thus reducing quantitatively the conversion of complex phosphates to orthophosphates and further affecting the precipitation reaction. Laminar liquid flow over rock is less efficient than turbulent chamber aeration, insofar as aluminum phosphate contact is concerned. Data shows that doses of aluminum to phosphorus above a ratio of 1:1 does not increase phosphorus removal. Once phosphorus has been insolubilized, the removal efficiency depends on particulate matter delivered to the final clarification in settleable form. Approach is not recommended where high phosphorus removal is needed. (D'Arezzo-Texas)
W70-04806

ANAEROBIC DIGESTION TREATS COTTON MILL DE-SIZE WASTES,
A. M. Buswell, and R. S. Ingols.
Wastes Engineering, Vol. 33, No. 8, p402-404, 428, 1962.

Descriptors: *Anaerobic digestion, Chemical oxygen demand, Costs.
Identifiers: *De-sizing, *Starch, Cotton mill wastes, Starch esters, Starch gums, Experimentation.

The de-sizing liquors may provide as much as one-half of the biochemical oxygen demand load and only 10% of the liquid effluent from a textile mill. Therefore it may be advisable to treat this concentrated material separately and this can often best be done by anaerobic digestion. Most of the size removed is starch or starch derivates. Laboratory experiments were made on pure solutions of such materials. About 90% of chemical oxygen demand was destroyed in an aerobic digestion with the gas produced being quite variable as compared with the theoretical yield. A capital cost of $40.00 per pound, per day for digesters was estimated. (Work - North Carolina State University)
W70-04807

NUMBERS AND TYPES OF MICROORGANISMS IN STABILIZATION POND EFFLUENTS,
New Hampshire Univ., Durham.
L. W. Slanetz, T. G. Metcalf, and C. H. Bartley.
New Hampshire Water Resource Research Center Project Completion Report, June 1968, 4 p. OWRR A-007-NH.

Descriptors: *Microorganisms, *Stabilization, *Ponds, *Effluents, Sewage, Coliforms, Streptococcus, Salmonella, Viruses, Bacteria, Organic matter, Indicators, Temperature, Pseudomonas, Seasonal, Water pollution.
Identifiers: Enteric, Survival rates, Flavobacter, Achromobacter, Kurthia, Antibiotics, Health, Indicator bacteria, Stabilization ponds.

Objective was to determine number and type of microorganisms in stabilization pond effluents compared to those present in raw sewage. Numbers and survival of coliforms, fecal coliforms, fecal streptococci, salmonellae, and enteroviruses in raw sewage and in stabilization pond effluents were determined in two community systems, the first containing three ponds and the second, four ponds, both receiving domestic waste. Survival rates for the indicator bacteria from pond effluents were obtained for both systems. Die-off rates were greater in summer than during winter. Salmonellae and enteric viruses were isolated from the majority of effluent samples tested from the first system, and, from the second system, Salmonellae were isolated from 19 out of 33 samples of raw sewage; and enteric viruses from 10 out of 10 Pond 4 effluent samples. The genera Flavobacter, Achromobacter and Pseudomonas were found to be the predominant bacteria that became established and grew in the pond systems. Filtrates from these organisms showed no antibiotic action against coliforms and fecal streptococci. Antibiotic activity against these organisms was demonstrated by the infrequent isolation of bacteria in the genus Kurthia. (Jones-Wisconsin)
W70-04819

TEXTILE WORKS EFFLUENT TREATMENT,
A. H. Little.
Textile Institute and Industries, Vol. 1, p9-11, 1963.

Descriptors: *Legislation, *Cost analysis, *Water pollution control, Pollution abatement, Waste waters, Waste water treatment, Waste disposal, Surface waters.
Identifiers: *Effluent treatment.

The author discusses the effect of recent British legislation concerning pollution on the textile industry, and indicates typical requirements for the discharge of waste waters to municipal sewers and to surface waters. He outlines possible methods of treatment for textile waste waters and indicates some of the costs of treatment and disposal. (Livengood-Mattox, North Carolina State University)
W70-04831

WASTE WATER CONTROL SYMPOSIUM.

American Dyestuff Reporter, Vol. 51, No. 10, p 358-364, 1962.

Descriptors: *Chemical wastes, *Domestic wastes, *Water pollution control, *Water conservation, Waste treatment, Biochemical oxygen demand, Fish, Toxicity, Waste treatment, Trickling filters, Biodegradation, Detergents.
Identifiers: *Dyeing wastes, *Slashing wastes, Starch, Sizes (Slashing), Sodium carboxymethylcellulose.

The Papers relating to textile wastes include: I. Factors causing pollution of rivers by wastes from the textile industry. II. The feasibility of treating textile wastes in connection with domestic sewage. III. Problems of textile chemical wastes. IV. Waste water control and water conservation. (See also W70-04850 thru W70-04853). (Livengood-North Carolina State Univ)
W70-04849

I. FACTORS CAUSING POLLUTION OF RIVERS BY WASTES FROM THE TEXTILE INDUSTRY,
Georgia Inst. of Tech., Atlanta. School of Applied Biology.
Robert S. Ingols.
American Dyestuff Reporter, Vol. 51, No. 10, p 358-359, 1962.

Descriptors: *Biochemical oxidation demand, *Chemical wastes, *Toxidity, *Turbidity, Temperature.
Identifiers: *pH, Sodium hydroxide, Starch, Sizes (Slashing), Carboxymethycellulose.

Pollution is defined as the degradation of water quality as result of mans' use which affects adversely the user of the water downstream. The factors causing pollution include BOD, certain 'inert' organic molecules, high pH values, toxic chemicals, color, turbidity and/or elevated temperatures. (See W70-04849). (Robinson-North Carolina State Univ)
W70-04850

II. THE FEASIBILITY OF TREATING TEXTILE WASTES IN CONNECTION WITH DOMESTIC SEWAGE,
Robert D. Wilroy.
American Dyestuff Reporter, Vol. 51, No. 10, p 360-362, 1962.

Descriptors: *Domestic wastes, *Waste treatment, Trickling filters, Activated sludge.
Identifiers: Bleaching wastes, Starch, Scouring waste.

The trickling filter or activated sludge unit is an aerobic process, and the sludge disgestion process is an anaerobic process. This difference in the processes had a definite bearing on the treatment of the various textile wastes when they are added to a sanitary sewer system. Each waste must be considered in relationship to its characteristics and the relative amount of sanitary wastes for which it can be treated. Pilot-plant studies are generally required with most large volumes to see if the waste can be treated with the sanitary wastes and to develop the necessary design information to do an adequate job. The sewer systems in several cities (Dalton, Georgia; LaGrange, Georgia; Greenville, South Carolina; and Lebanon, Tennessee) which combine textile and industrial wastes are discussed. (See W70-04849). (Robinson-North Carolina State Univ)
W70-04851

III. PROBLEMS OF TEXTILE CHEMICAL WASTES,
Charles Starling.
American Dyestuff Reporter, Vol. 51, No. 10, p 362-363, 1962.

Descriptors: Detergents, Biochemical oxidation demand.
Identifiers: *Biodegradability.

When a waste component exerts a BOD, it is converted to the oxygen equivalent of carbon dioxide, animal protoplasm or vegetable cells, and the problem is through and done when the BOD is satisfied either in a treatment works or in the natural course of the stream travel. When the soluble component of the waste exerts no BOD it stays in its carrier indefinitely. The problem then becomes what concentration of these indestructable wastes can be tolerated in streams and how far are we justified in attempting to solve our waste problems by substituting indestructable materials for those which are destroyed by biochemical oxidation. The best interest of streams are wastes which are 100% biodegradable. The problem of textile chemicals in wastes contains many variables and unknowns. Manufactures of textile chemical specialties should have a primary responsibility in developing new and more biodegradable products. (See W70-04849). (Robinson-North Carolina State Univ)
W70-04852

IV. WASTE WATER CONTROL AND WATER CONSERVATION,
R. Hobart Souther.
American Dyestuff Reporter, Vol. 51, No. 10, p 363-364, 1962.

Descriptors: *Water conservation, Control.
Identifiers: Bio-aeration.

Progress in pollution abatement in the past has been handicapped by the relatively high cost of treatment, due partly to use of outmoded conventional processes. Wet-processing industries in the United States have contributed more in research toward cleaning up streams than governmental agencies. Since capital and operational costs of new types of waste treatment plants are much lower than conventional trickling filter or activated sludge plants, other industrial groups and cities treating industrial waste may be expected to follow with low cost bio-aeration plants. (See W70-04849). (Robinson-North Carolina State Univ)
W70-04853

TREATMENT OF INDUSTRIAL WASTE WATERS IN THE UNITED STATES,
H. H. Black.
Bulletin Mensuel, Centre Belge d'Etude et de Documentation des Eaux, Liege, Belgium, Vol. 34, No. 71, p 246-262, 1956.

Descriptors: *Waste water treatment, Oil wastes, Treatment facilities.
Identifiers: *Textile wastes, Food processing wastes.

Descriptions are given of the treatment in the United States of America of waste waters from oil refineries, motor car manufacture, milk trade, food processing, textile industry. Flow diagrams and photographs of some of the plants are given. (Livengood-North Carolina State Univ)
W70-04895

NITROGEN RELATIONSHIPS IN BIOLOGICAL TREATMENT PROCESSES--I. NITRIFICATION IN THE ACTIVATED SLUDGE PROCESS,
Texas Univ., Austin. Environmental Health Engineering Research Lab.
S. Balakrishnan, and W. W. Eckenfelder.
Water Research (J Int Assn on Wat Pol Res), Vol 3, No 1, pp 73-81, January 1969. 7 fig, 4 tab, 11 ref.

Descriptors: *Nitrification, *Activated sludge, *Organic loading, Aeration.
Identifiers: *C:N ratio, Rate constants, Raw sewage, Mixed liquor, Loading factor, BOD, COD, Kjeldahl nitrogen, Synthetic wastewater, MLSS.

This is the first in a series of three articles. The second is similar to this but on the trickling filter and the third is on denitrification. The authors found complete nitrification when the organic loading factor did not exceed 0.3-0.4, provided the other conditions were optimal. There is a minimum sludge age of 3 to 4 days for good nitrification at 23 deg C. The nitrification increased with an increase in the ammonia applied, but the increase in nitrification was at a slower rate than that for the ammonia. Batch runs indicated that nitrification can be formulated by both the autocatalytic and first order reactions. Complete nitrification of the final effluent is obtained by an aeration period of 8 hrs at a MLSS concentration of 2800 mg/l. Oxygen demand of the mixed liquor ranged within 10 percent of the theoretical requirements for both nitrification and BOD removal. (Ledbetter-Texas)
W70-04896

NEW ZEALAND WOOL SCOURING LIQUORS - TREATMENT AND POTASSIUM RECOVERY,
New Zealand Wool Industries Research Inst., Inc., Dunedin.
J. L. Hoare, R. G. Stewart, and B. J. Sweetman.
New Zealand Journal of Science, Vol. 12, No. 2, p 237-251, 1969. 33 ref, 4 tab, 2 fig.

Descriptors: *Potassium compounds, Domestic wastes, Laboratory tests.
Identifiers: *Wool scouring, *Wool grease, Acid cracking.

Laboratory investigations were made of commercial wool scouring waste liquids to determine the amount of potassium salts present and recover them and also methods of acid cracking to cause wool grease to separate from the water solution. It was concluded that the recovery of potassium salts could not be economically justified. Hard cracking alone produces poor phase separation and the process would require additional chemical or other method of flocculation. It is felt that the most satisfactory method of treatment of wool scouring waste is in conjunction with domestic wastes in conventional sewage treatment plants. (Work-North Carolina State Univ)
W70-04897

CONTROL OF ALKALINE SCALE USING CARBON DIOXIDE SUPPRESSION,
Oak Ridge National Lab., Tenn.
For primary bibliographic entry see Field 03A.
W70-04930

WASTE TREATMENT STUDIES AT CLUETT, PEABODY AND COMPANY FINISHING PLANT,
Cluett, Peabody Co., Inc., New York.
R. H. Souther.
American Dyestuff Reporter, Vol. 58, No. 15, p 13-16, 1969. 4 tab, 6 ref.

Descriptors: Hudson River, Biochemical Oxygen Demand, Alkalinity.
Identifiers: *Textile finishing plant, *Mercerizing, *Caustic soda, *Caustic recovery, Mohawk River, Desizing, Scouring, Bleaching, Fabric, Textile mill wastes.

A textile finishing plant, located at the confluence of the Mohawk and Hudson rivers, had potential pollutants resulting from natural impurities on fabrics and from the processing chemicals used in the desizing, scouring, mercerizing, bleaching and finishing operations. Installation of caustic soda recovery units eliminated hydroxyl alkalinity and reduced pollution loading by about 50%. They made it possible to remove 97% of BOD from the effluent water, as compared with about 65% efficiency obtainable with the previous highly alkaline effluent. Tank sizes and retention times in the bio-aeration process were reduced. It was felt that the installation of a filter plant and ion-exchanger would make it possible to recirculate water. (Work-North Carolina State University)
W70-04945

ECONOMICS OF RECLAIMED WATER IN DYEWORKS.

International Dyer, Vol. 141, No. 5, p303-304, 1969.

Descriptors: *Activated carbon, *Water reuse.
Identifiers: *Carpet mill wastes, Dyestuffs, *Dyehouse wastes.

A bed of activated carbon is used to absorb dyestuffs from the 500,000 gal/day of effluent water from the dyehouse of a carpet mill, after which the water is reused. The carbon is on a moving bed and is regenerated by high temperature treatment as often as is required by the loading rate. (Work-North Carolina State University)
W70-04946

CURRENT PRACTICE IN SOLVENT SCOURING AND ITS FUTURE DEVELOPMENTS,
Tingey-Moss Ltd.
G. I. Hollings, and J. Ruddy.
The Textile Institute and Industry, January 1970, p12-15, 5 tab, 2 fig.
Identifiers: *Dyehouse wastes, *Solvent scouring, Textile mill wastes, Starch, Warp sizes, Sizing wastes.

The use of solvent scouring to replace conventional systems completely eliminates the problem of disposing of highly alkaline wash liquors. A small amount of water is required to remove accumulations of sizing on the equipment, the sizing having been reduced from about 10% to 2 to 4% in the solvent process. Aqueous scouring, following the solvent scouring, may be required to remove those residual amounts of starch sizes from fabrics based upon cotton or cotton blends. (Work-North Carolina State University)
W70-04960

BIOLOGICAL TREATMENT SOLVES DYEWORKS EFFLUENT PROBLEMS,
J. E. Felstead.
Water and Waste Treatment Journal, Vol. 11, p127-129, 1966.

Descriptors: *Activated sludge, Detergents, Biochemical oxygen demand.
Identifiers: *Dyehouse wastes, *Dyes, Nylon.

Treatment facilties were developed for waste waters from the textile dyeing and finishing plant of Joshua Wardle Ltd. at Lee, England. This involved preliminary chemical analyses of minor effluents and laboratory-scale trials on composite effluents. The waste waters were formerly passed over alumina ferric blocks and settled before discharge but the effluent failed to comply with the standards laid down by the Trent River Authority. The waste waters from the 2 mills, in nature mainly organic, but also containing low concentrations of a variety of other compounds such as inorganic salts and bases, are now pumped first to a holding tank, and then to 2 activated-sludge tanks fitted with Simcar aerators. After secondary sedimentation, the final effluent is discharged to the river Churnett, a tributary of the river Dove. (Work-North Carolina State University)
W70-04961

SIMPLIFIED CHEMICAL TREATMENT OF WASTE WATER FROM TEXTILE FACTORIES WITH CLARIFYING, FLOCCULATING, AND PRECIPITATING AGENTS (IN GERMAN),
K. R. Dietrich.
Textil-Praxis, Vol. 22, No. 2, p126-127, 1967. 1 tab, 5 ref.

Descriptors: *Flocculation, Iron compounds, Calcium compounds, Biochemical oxygen demand, *Phosphorus compounds, Chemical precipitation.
Identifiers: *Textile mill wastes, *Precipitation, Silicon compounds, Dyes, Aluminum compounds.

Mixtures of electrolytes containing Al3+, Fe3+, Fe++, Si4+, and Ca++ are more effective flocculating agents than those containing only Fe3+ cations. Applied to textile plant sewage at <50mg./l., the mixtures drastically reduce the organic matter, ppt. or absorb dyes and P compounds, and improve the drying of the sludge; the effects are largely independent of pH. Thus, in 1 case, the treatment reduced the BOD from 215 to 25 mg. 0/1. and the KMnO4 consumption from 1005 to 320 mg./l., while the pH changed from 7.5 to 6.8 and the settling solids from 20 to 175 mg./l. This obviates further pH adjustment, rock filtration, or ion exchange treatment. (Work-Livengood-North Carolina State University)
W70-04962

PROBLEMS OF EFFLUENT DISPOSAL,
Spence (Peter) and Sons Ltd., Widnes (England).
J. H. Harwood.
Textile Manufacturer, Vol. 89, p33-34, 1963.

Descriptors: *Sewers, Sedimentation, Biological treatment, Aeration, Neutralization, Chemical precipitation, Sludge disposal, Filtration.
Identifiers: *Effluent disposal, *Dyehouse wastes, Dyeing wastes, Finishing wastes, Balancing tanks, pH control, Segregation, Screening, Chemical oxidation, Biological oxidation.

The most acceptable solution for industralists is to have their effluent accepted into public sewage systems whenever possible. Costs would be lower than for construction and operation of individual plants. The minimal equipment at a treatment plant consists of balancing tanks, pH adjustment, and sedimentation equipment. If wastes are discharged into streams, biological treatment may also be necessary. Where several types of treatment are carried out on the same site, adequate mixing is essential. Any or all of the following items may be needed: (a) segregation of wastes, (b) balancing and storing, (c) screening, (d) aeration, (e) neutralization, (f) chemical precipitation, (g) chemical oxidation, (h) filtration, (i) biological oxidation, (j) sludge disposal. (Robinson-North Carolina State University)
W70-04963

TEXTILE WASTE TREATMENT AT CANTON COTTON MILLS,
Canton Textiles, Inc.
L. L. Jones, Jr.
Journal of Water Pollution Control Federation, Vol 37, No 12, p 1693-1695, 1965.

Descriptors: Dissolved oxygen, Biochemical oxidation demand, Solid wastes, Color.
Identifiers: *Biological aeration, *Starch wastes, *Dyeing wastes, *Dyehouse wastes, Biological waste tank.

The prolonged biological aeration method was chosen for use at this plant. Starch wastes, with high biochemical oxidation demand and low volume, are desirable as nutrients for microorganisms. Dye house wastes constitute a majority of wastes and are the most varied types. The biological oxidation process gives satisfactory treatment of sewage and mill wastes with an efficiency of removal of biological oxidation demand of 90% after 20 hours aeration. The process is described, and descriptions of equipment, costs, and comparisons of influent and effluent are given. (Robinson-North Carolina State Univ)
W70-04964

THE TREATMENT OF STRONG INDUSTRIAL WASTES ON THE CONTINENT,
M. Kehren.
Ciba Review, No 121, p 25-27, 1957.

Descriptors: *Chemical precipitation, *Biological treatment.
Identifiers: Niers process, Sedimentation tanks.

The normal sequence of treatment is a combination of wastes in (a) central sedimentation tank, (b) chemical precipitation followed by settling, (c) biological treatment after waste has passed through a secondary settling tank, and (d) removal of biological sludge in a third settling tank. The Niers process is described. (Robinson-North Carolina State Univ)
W70-04965

FLOCCULATION OF TRADE WASTES WITH IRON COMPOUNDS,
M. Kehren.
Ciba Review, No 121, p 22-24, 1957.

Descriptors: *Chemical precipitation.
Identifiers: *Iron salts, *Ferrous compounds, *Basic dyes, *Acid dyes, *Direct dyes, *Vat dyes, *Sulphur dyes, *Developed dyes, Ferrous sulphate, Ferric chloride, Ferric compounds, Dyehouse wastes.

The approved forms of iron available for application to wastes are as follows: (1) Iron metal turnings and (2) Iron salts (ferrous sulphate, chlorinated copperas, ferric chloride). Systematic treatment of waters containing dyestuffs with iron or iron salts has led to the following conclusions: (1) Treatment with iron salts needs less iron than application of elementary iron. (2) Ferrous compounds are less economical of iron than ferric. (3) With optimum clarifications, divalent iron remains partly unflocculated in the settled liquid and requires after-flocculation. (4) Coagulation is most effective in the pH range of 5.5-6.1. (5) Around the isoelectric point, low concentration of dyestuffs requires relatively large amounts of iron for their removal. (6) In the alkaline range, no clarification occurs if the iron and dye concentrations are between 20 and 100 p.p.m., though considerable iron flocculation takes place. (7) In the strongly acidic range, a given concentration of iron coagulates large amounts of dye, while an increasing proportion of iron remains unflocculated. (8) The dye concentrations most economical of iron range from 100-150 p.p.m. The treatments for basic dyes, acid dyes, direct dyes, vat dyes, sulphur dyes, and developed dyes are described.
W70-04966

TREATMENT OF WOOL SCOURING WASTES WITH COLLOIDAL BENTONITE,
Agricultural Research Service, Albany, Calif. Western Utilization Research and Development Div.
W. Fong, and H. P. Lundgren.
Textile Research Journal, Vol 25, p 994-1000, 1955.

Descriptors: *Bentonile, Chemical oxygen demand.
Identifiers: *Wool, *Wool-scouring wastes, Wool grease, Suint, Scouring wastes, Acid-cracking process, Centrifugal process.

A dispersible-type bentonite produces a marked improvement in the extent of clarification of the waste effluent from the conventional acid cracking of wool. The scouring wastes are acidified with sulfuric acid to a pH level between 3 and 4 and then the required amount of bentonite is added as an aqueous dispersion. The amount of waste between 0.1 and 0.5% is generally sufficient. Treatment of a standard waste with acid and bentonite removed as much as 96% of the grease compared with removal of 67% with acid alone. The chemical oxygen demand was reduced by approximately 60% by the combination treatment, compared with 33% reduction with acid alone. (Work-North Carolina State Univ)
W70-04967

DISPOSAL AND CLARIFICATION OF LIQUID WASTES,
M. Kehren.
Ciba Review, No 121, p 13-22, 1957.

Descriptors: *Percolation, *Trickling filters, *Activated sludge, *Sludge treatment, *Chemical precipitation.
Identifiers: *Clarifiers, *Settling tanks, *Biological purification, *Spray irrigation.

The following treatment methods are described: clarifiers and settling tanks, percolation, biological purification, trickling filters, activated sludge process, sludge treatment, spray irrigation, and chemical precipitation. (Robinson-North Carolina State Univ)
W70-04968

THE PROBLEM OF WASTE WATER TREATMENT,
M. Kehren.
Ciba Review, No 121, p 4-7, 1957.

Descriptors: *Self-purification.
Identifiers: Oxygen depletion.

In biological self-purification, bacteria oxidize or reduce wastes aerobically or anaerobically. Too much load on a stream will upset its recuperative power, and continuous oxygen depletion causes extinction of practically all living matter in water. Photomicrographs of protozoa which oxidize or reduce wastes are included. (Robinson-North Carolina State Univ)
W70-04970

SOME DIFFERENCES BETWEEN BRITISH, AMERICAN, AND CONTINENTAL PRACTICE,
L. Klein.
Ciba Review, No 121, p 3, 1957.

Descriptors: *Biological treatment, *Analytical treatment.

Most of the methods are similar. American industries are more willing to pay for waste treatment. Biological treatment is more common in Great Britain and on the Continent. The small size of British rivers requires a higher degree of treatment. Chemical tests are all similar. (Robinson-North Carolina State Univ)
W70-04971

POLLUTION REDUCTION IN COTTON FINISHING WASTES THROUGH PROCESS CHEMICAL CHANGES,
J. W. Masseli, and M. G. Burford.
Sewage and Industrial Wastes, Vol 26, p 1109-1116, 1954.

Descriptors: *Pollution abatement, *Water pollution sources, Effluents, Biochemical oxygen demand, Soaps, Data collections.
Identifiers: *Cotton finishing wastes, *Substitute chemicals, *Scouring waste, *Desizing wastes, Process chemicals, Starch, Cotton waxes, Pectins, Cellulose ethers.

Results of an effluent survey of a cotton finishing plant were compared with data derived from an inventory of the BOD values of process chemicals used. The former indicated a discharge of 123 pounds and the latter 155 pounds BOD per 1,000 pounds of cloth. Process chemicals were shown to contribute 70-80% of the total BOD with starch, soap, and ACOH the major sources; 20-30% of the BOD was attributed to the natural waxes and pectins extracted from the cotton fiber during scouring. The possibilities are indicated of pollution reductions of 50-75% by substitution of low BOD chemicals for those now used; cellulose ethers for starch. Desizing and scouring contribute 35 and 32% of the total BOD, respectively. (Mattox, Livengood-North Carolina State Univ)
W70-04972

SOME EFFLUENT STUDIES WITH BLEACHING LIQUORS,
Laporte Chemicals Ltd., Luton (England).
L. Chesner, and F. W. Roberts.
Textile Institute and Industry, Vol 1, No 5, p 10-12, 1963. 6 tab.

Descriptors: Biochemical oxygen demand, Domestic wastes.
Identifiers: *Textile mill wastes, *Bleaching plant wastes, *Caustic, Kier processing, Starch desizing, Scouring, Bleaching, Sodium hypochlorite, Cotton, Cotton impurities, Hydrogen peroxide, Peracetic acid, Percolating filters.

Table 1 presents numerical data on the BOD of chemicals used in the textile industry. Table 2 gives the 'population equivalent' per weight of fabric processed. Table 3 presents data for BOD per weight of fabric in selected wet-processing operations. Table 4 analyses waste liquids from caustic scour and bleaching. Table 5 gives the properties of waste water from kiering (scour and bleach). Table 6 is an analysis of effluents from percolating filters processing the waste water in Table 5. The conclusion is made that caustic kier waste water can be purified to the 80-90% level of its first neutralized and if nitrogen is made available either by chemical addition or by mixture with domestic sewage. (Work-NorthCarolina State Univ)
W70-04973

APPLICATION OF CHLORINE AND TREATMENT OF TEXTILES WASTES,
Wallace and Tierman, Inc., Belleville, N.J.
N. S. Chamberlain.
Proceedings of the Third Southern Municipal Industrial Waste Conference, Raleigh, North Carolina, p 176-189, 1954.

Descriptors: Lime, Chlorine, Chemical precipitation.
Identifiers: *Textile mill wastes, *Coagulating, Chemical treatments, Ferrous sulfate, Sulfuric acid.

There is a diversity of waste products from textile mills and therefore, in order to secure coagulation of wastes, the chemistry of these must be known. Batch processes may be preferred, especially where individual chemical wastes can be used to destroy each other. The preferred chemicals to assist coagulation and precipitation of solids are ferrous sulfate, lime and sulfuric acid. Chlorine can be used both for this purpose and to purify effluent waters. (Work-North Carolina State Univ)
W70-04974

PILOT-PLANT TREATMENT IN SEWAGE-TEXTILE WASTE MIXTURES,
Camp, Dresser, and McKee, Boston, Mass.
R. H. Culver.
Journal Boston Society Civil Engineers, Vol 45, p 227-248, 1967. 8 fig, 3 tab.

Descriptors: *Biochemical oxygen demand, Biological treatment, *Trickling filters, Vat dyes, Activated sludge.
Identifiers: *Textile mill wastes.

Before designing a new treatment plant to handle about 11 m.g.d., of which about 40 percent is textile waste, pilot-plant studies were carried out on treatment of the mixed sewage and waste waters by various biological methods. It was concluded that an effluent with a BOD of about 50 mg/l. could be obtained by two-stage biological treatment if the pH value of the influent was reduced to less than 9.5. This can be achieved by treatment with flue gas. First-stage biological treatment on a percolating filter operating with recirculation stabilizes the system and prevents shock loads affecting the subsequent activated-sludge process. The suspended solids in the mixed liquor from the activated-sludge units settle only slowly and coagulation before final sedimentation is necessary to give a well-clarified effluent. About 80 percent of the indigo dye in the waste waters is adsorbed on the biological flocs during treatment. The amount of sludge produced is too small to be used as a source of gas for power production, and therefore the process should be operated so as to produce a minimum quantity of sludge. (Work-North Carolina State Univ)
W70-04975

LEGAL AND PRACTICAL PROBLEMS OF EFFLUENT DISPOSAL,
Spence (Peter) and Sons Ltd., Widnes (England).
J. H. Harwood.
Journal of the Society of Dyers and Colourists, Vol 77, No 11, p 537-543, 1961.

Descriptors: *Legislation, *Sedimentation, Coagulation, Biological ttreatment, Neutralization, Lime, Anaerobic digestion, Sludge treatment.
Identifiers: *Dyehouse wastes, Effluent disposal, Waste treatment plant, Balancing tanks, pH control, Kestner neutralizer, Sedimentation tanks, Aluminum sulphate, Unifloc process, Aluminum lakes, Sodium hypochlorite, Dyes, Textile mill wastes.

The legal position affecting the disposal of trade effluent in sewers, rivers, and estuaries is reviewed. The major portion of the report deals with various treatment processes. The minimum equipment necessary to treat a normal works' effluent consists of balancing tanks and pH adjustment, and sedimentation equipment. The three general types of tanks used are horizontal flow, upward flow, and radial flow. The major types of sedimentation plants are those which use solid reagents, fill-and-draw units, and continuous-flow units. The least expensive method of sludge disposal is to pump the sludge onto the ground and allow it to dry. Many dyes may be decomposed by anaerobic treatment. Paper mill wastes are best disposed of by addition of coagulants before sedimentation. For tannery effluents, chemcial precipitation can reduce the load on biological filters by one-half. Unless the effluent is discharged to a domestic sewer, coagulation is not sufficient. Highly colored dyehouse and textile wastes are successfully treated by formation of aluminum lakes. Soluble dyes can be removed by sodium hypochlorite treatment. (Robinson-North Carolina State Univ)
W70-04976

DEVELOPMENTS AND EQUIPMENT IN EFFLUENT TREATMENT,
J. G. Kennedy
International Dyer, Textile Printer, Bleaches and Finishes, Vol 133, No 12, p 939-947, 1965. 3 diagrams.

Descriptors: *Sewers, Calcium chloride, Waste treatment, Pilot plants, Sludge treatment.
Identifiers: *Wool grease, *Viscose rayon, Fiber production wastes (Synthetics), Textile wastes, Scouring, Biological purification, Physiochemical purification.

One solution to the treatment problem is that industrial wastes may be partially treated before dumping them into municipal sewers, or the wastes may be dumped directly into the sewers. Where a large capital sum is involved or an unknown type of effluent is to be treated, pilot plants are generally erected before embarking on the main scheme. The separation of wool grease by precipitation with calcium chloride is discussed. Methods employed to prevent pollution of the Danube by viscose manufacturing waste are mentioned. An example of the treatment of effluents from a dye manufacturing plant is also given. Two of the newer processes for treatment are the Water Engineering, Ltd., three-stage process which is a complete effluent treatment process suitable for chemical and food industries and stringe discharge filters developed by Stockdale Engineering, Ltd. In summation, the wastes from every plant are different and therefore the type of process chosen depends on the type of waste, amount of waste, and requirements by local authorities. (Robinson-North Carolina State Univ)
W70-04977

AMMONIA REMOVAL FROM AGRICULTURAL RUNOFF AND SECONDARY EFFLUENTS BY SELECTED ION EXCHANGE.
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.

Available from the Clearinghouse as PB-187 759, $3.00 in paper copy, $0.65 in microfiche. FWPCA, Ohio Basin Region, Robert A. Taft Sanitary Engineering Ctr, Report TWRC-5, March 1969. 58 p. Grant WPRD 26-01.

Descriptors: *Ammonia, *Ion exchange, Calcium, Silicates, Wastewater treatment, *Farm wastes, Nitrogen, *Zeolites.
Identifiers: *Clinoptilolite, Strippers, Ammonia removal.

A selective ion exchange process was developed for removal of ammonia nitrogen from wastewater. The process employs a natural zeolite, clinoptilolite, which is selective for ammonium ions in the presnece of sodium, magnesium, and calcium ions. Regeneration of the exhausted clinoptilolite is accomplished with solutions or slurries containing lime. Lime provides hydroxyl ions which react with the ammonium ions to yield an alkaline aqueous ammonia solution. This ammonia solution is processed through an air stripping tower to remove the ammonia which is exhausted harmlessly to the atmosphere. The spent regenerant is then fortified with more lime and recycled to the zeolite bed to remove more ammonia. Since the regenerant is not discarded, the process generates no liquid wastes. The ion exchange equilibria of four zeolites was investigated and clinoptilolite was selected for further study on the basis of its ammonium ion selectively and low cost. Operation of the mobile plant with secondary effluent resulted in ammonia removals of 97 and 93 percent at 70,000 and 100,000 gallons per day respectively; thus demonstrating that selective ion exchange provides a highly effective means for removing ammonia from wastewater.
W70-04982

5E. Ultimate Disposal of Wastes

DISPOSAL OF BRINE BY SOLAR EVAPORATION: LABORATORY EXPERIMENTS,
New Mexico State Univ., University Park.
C. G. Keyes, Jr., D. C. Winans, C. Morales, H. R. Pritchett, and W. S. Gregory.
Office of Saline Water, Research and Development Progress Report No. 548, April 1970. 152 p. OSW Contract 14-01-0001-969.

Descriptors: *Brine disposal, *Evaporation, *Energy balance, *Evaporation pans, *Laboratory tests.
Identifiers: *Evaporation enhancement, *Dyes.

An experimental study was carried out to determine the effects of wind, temperature, solar radiation, water depth and dyes on the evaporation rate of brine solutions. Naphthol Green dye decreased the evaporation of a 12% brine solution in most cases (depths from 0.25 to 1.5 feet), except at the 1.25 foot depth; i.e., the optimum evaporation depth for the brine with Naphthol Green. It was also observed that evaporation decreased as the concentration increased except around the 12.4% brine level. The upper (17.4%) and lower (0.3%) concentrations produced a different response for temperature and saturation vapor pressure. As radiation increased to a peak value then decreased one value, there was a radiation value which produced a minimum amount of evaporation. This same effect occurred for the saturation vapor pressure and the bulk temperatures.
W70-04891

DISPOSAL OF BRINE BY SOLAR EVAPORATION: DATA,
New Mexico State Univ., University Park.
C. G. Keyes, Jr., N. N. Gunaji, J. V. Lunsford, J. G. Seckler, and O. D. Richard.
Office of Saline Water Research and Develop. Progress Report No. 547, April 1970. 154 p. OSW Contract 14-01-0001-969.

Descriptors: *Brine disposal, *Evaporation, *Energy balance, *Mathematical models, *Computer models, Solar radiation, Heat balance, Heat budget.
Identifiers: *Evaporation rates, Brine evaporation, Theoretical studies.

The disposal of brine by means of solar evaporation has been extensively studied in many arid and semi-arid regions. Efforts to accelerate the evaporation rate have also been made in order to utilize solar methods in areas where the net evaporation is relatively low. The experimental program consisted of studying the effect of Bismark Brown, Congo Red, Methylene Blue, Naphthol Green and Nigrosine Dyes on the solar evaporation of brine. To evaluate the effect of dye on the solar evaporation of brine, three basic methods were employed: (1) Mass Transfer, (2) Energy Budget, and (3) Water Budget. The results of this report consists only of the data furnished to the computer.
W70-04892

5F. Water Treatment and Quality Alteration

UNDER THE RUG,
Colorado School of Mines, Golden. Mineral Resources Inst.
For primary bibliographic entry see Field 05G.
W70-04589

5G. Water Quality Control

DESALTING CALIFORNIA,
California State Dept. of Public Health, Sacramento. Environmental Sanitation Div.
Frank M. Stead.
Environment, Vol 11, No 8, p 2-10, June 1969. 9 p, 5 photo, 1 map.

Descriptors: *Drainage systems, *Drainage water, *Return flow, *Irrigation programs, *California, Diversion loss returns, Water pollution sources, Nutrients, Saline water.
Identifiers: Central Valley (California).

California's Central Valley, one of the most productive farming areas in the world, suffers salt accumulation from irrigation water residues. A master drain is proposed to remove saline irrigation waste water. No safe discharge point can be found. The proposed drain would be the sole drainage outlet for lands soon to be irrigated by the California Aqueduct, and would also serve those presently irrigated lands where excess salt in the soil profile or high water tables currently threaten the production of high crop yields. The central concern is that the

discharge of water from the drain would have a disastrous impact upon the ecology of the San Francisco Bay and the delta systems as a result of nutrients, pesticides and salts in the drainage water. Evaporation, desalination and reuse of waste waters and nutrients are proposed as an alternative to export. (Knapp-USGS)
W70-04583

UNDER THE RUG,
Colorado School of Mines, Golden. Mineral Resources Inst.
David M. Evans, and Albert Bradford.
Environment, Vol 11, No 8, p 3-13, 31, October 1969. 12 p, 6 fig, 1 tab, 29 ref.

Descriptors: *Waste disposal, *Injection wells, *Aquifers, Industrial wastes, Recharge, Corrosion, Public health, Safety, Water pollution sources, Water pollution effects, Earthquakes, Water pressure.
Identifiers: *Waste disposal wells.

Legislative control of underground waste disposal, the techniques of disposal, and possible effects of the use of disposal wells are reviewed. Few states regulate in any specific way what substances go underground. Many industries and government agencies are taking advantage of this gap in control laws and are now dumping their toxic wastes below the ground through deep injection wells. Such wells are usually cheap to build and operate compared with the cost of cleaning up wastes or storing them, but they offer only temporary safety from the many permanently toxic wastes being injected. The industrial wastes going down deep wells range from steroids and photographic chemicals to uranium tailings. At the Rocky Mountain Arsenal in Denver, wastes from the manufacture of poison gas had been dumped into above-ground holding ponds since 1943. A month after injection began, Denver had its first earthquake in 80 years, and in November 1965, the 710 Denver earthquakes recorded by that time correlated with the volumes of fluid pumped into the Arsenal well. Discontinuation of many wells in service and very careful study of the need and desirability of any new wells are recommended. In general, treatment for nonpolluting surface disposal of industrial wastes is safer and more desirable than underground disposal of raw or dangerous wastes. (Knapp-USGS)
W70-04589

CLARIFICATION OF TURBID WATER WITH POLYELECTROLYTES FOR RECHARGE THROUGH WELLS,
Technion-Israel Inst. of Tech., Haifa. Sanitary Engineering Lab.; and Agricultural Research Service, Bushland, Tex. Southern Plains Branch.
For primary bibliographic entry see Field 04B.
W70-04609

COMPLEMENTARY-COMPETITIVE ASPECTS OF WATER STORAGE (An Engineering-Economic Approach to Evaluate the Extent and Magnitude of the Complementary and Competitive Aspects of Water Storage for Water Quality Control),
Sacramento State Coll., Calif. Dept. of Civil Engineering.
Kenneth D. Kerri.
Available from the Clearinghouse as PB-190 197, $3.00 in paper copy, $0.65 in microfiche. Water Pollution Control Research Series DAST-1, Dec, 1969. 190 p, 6 tab, 10 fig, 37 ref, 5 append. FWPCA Program No. 16090DEA---12/69.

Descriptors: *Allocation, *Flow Augmentation, Marginal analysis, Planning, *Reservoir operation, *Simulation, Temperature control, Water pollution, Water quality.

Allocation of scarce water for flow augmentation to enhance water quality and other beneficial uses conflicts with other water demands. An analytical model is proposed that is capable of allocating water to competing demands on the basis of economic efficiency. The value of water is determined from the slopes of the benefit functions for water uses and an algorithm, based on the theory of marginal analysis, allocates water after considering the complementary and competitive uses of available water. Operations strategies may be selected and revised throughout the demand period regarding the amount of water to remain in storage, or stored and then released for downstream uses or downstream diversions. Results predict the frequency and magnitude of shortages for each beneficial use of water. Simulation of the hydrologic and economic systems of the proposed Holley Reservoir in the Willamette Valley in Oregon was used to test the effectiveness of the proposed analytical model and the results appear very good. A daily streamflow model and a relationship between reservoir operation and recreational attendance were developed to produce an accurate simulation of the basin. Planners, designers, and operations personnel are provided with a method of allocating water in proposed and existing systems. This method indicates the value, extent and magnitude of the complementary and competitive aspects of water storage for water quality control.
W70-04653

MIGRATION OF POLIOVIRUS TYPE 2 IN PERCOLATING WATER THROUGH SELECTED OAHU SOILS,
Hawaii Univ., Honolulu. Water Resources Research Center.
Daniel H. Hori, Nathan C. Burbank, Jr., Reginald H. F. Young, L. Stephen Lau, and Howard W. Klemmer.
Available from the Clearinghouse as PB-190 271, $3.00 in paper copy, $0.65 in microfiche. Technical Report No 36, Hawaii Water Resources Research Center, January 1970. 40 p. OWRR Project A-001-HI.

Descriptors: *Viruses, Groundwater, Water pollution, Absorption, *Leaching, *Percolation.

A laboratory study was made to determine the ability of three Oahu soils, Wahiawa, Lahaina, (both Low Humic Latosols), and Tantalus cinder to prevent possible contamination of the basal-water lens by the passage of virus. The study was performed utilizing columns containing the selected soils and subject to intermittent percolating water containing a known concentration of Poliovirus Type 2, simulating the action of a cesspool leaching into the ground. The effluent from the soil column was collected and analyzed for viral content by the plaque forming techniques. Breakthrough of the virus occurred in both Wahiawa and Lahaina soils at soil thicknesses of 6-inch, 2 1/2 inch, and 1 1/2 inch at applied concentration of 150,000 pfu/ml of feed solution. The virus removal was over 97 percent of the applied titer. The Tantalus cinder proved ineffective in withholding the virus at the applied concentration of 150,000 pfu/ml of feed solution. The virus breakthrough varies between 39 percent to 78 percent of the applied titer.
W70-04688

UTILITIES ON PERMANENT SNOWFIELDS,
Army Terrestrial Sciences Center, Hanover, N.H.
For primary bibliographic entry see Field 03D.
W70-04740

BOTTOM FAUNA STUDIES OF THE LOWER SABINE RIVER,
North Texas State Univ., Denton. Dept. of Biology.
Albert Hendricks, William M. Parsons, Don Francisco, Kenneth Dickson, and Don Henley.
The Texas Journal of Science, Vol 21, No 2, p 175-187, 1969. 3 fig, 4 tab, 18 ref.

Descriptors: *Benthic fauna, Pulp and paper industry, Environmental effects, Texas, Louisiana, Tidal effects, Hydrogen ion concentration, Oxygen, Stratification, Silts, Sands, Muck soils, Organic matter, Forests, Grasses, Swamps, Snakes, Turtles, Cyanophyta, Conductivity, Insects, Crustaceans, Annelids, Mollusks.
Identifiers: *Lower Sabine River (Texas), Salt water wedge, Hexagenia, Caenis, Dromogomphus, Somatochlora, Aphylla, Telebasis, Hetaerina, Tendipes, Chaoborus, Phylocentropus, Mysis, Gammarus, Sphaeroma, Lumbriculus, Branchiuris, Helobdella, Polymesoda, Uniomerus, Notonecta, Pristina, Mytilopsis, Rhantus, Asellus, Laeonereis.

Bottom fauna inhabiting the Lower Sabine River from Morgan Bluff to the Interstate 10 Bridge over the Sabine River, Texas-Louisiana, were the subject of periodical sampling from the summer of 1965 to spring 1968. The purpose was to determine the biological condition of that portion of the river before and during the time that the Owen-Illinois Paper Manufacturing plant was discharging waste. This report enumerates the organisms found at different stations along the river, their habitats and the particular effects of the environment upon them. All organisms reported were collected before any waste from the paper mill had been discharged into the river, except those collected in the spring of 1968. Dissolved oxygen and temperature varied very little among the sampling stations. It appears that during period of low stream flow, the salt water wedge becomes the primary controlling factor over the bottom dwelling organisms in the stream. Type of substrate material appeared to influence to a certain extent the bottom fauna population. It is proposed that periodic high flows of fresh water are instrumental in flushing out the salt water and repopulating portions of the river. (Jones-Wisconsin)
W70-04808

CONTROL OF SULFATE-REDUCING BACTERIA,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Microbiology Section.
Ronald F. Lewis.
Journal American Water Works Association, Vol 57, No 8, p 1011-1016, 1965. 1 tab, 20 ref.

Descriptors: *Bacteria, *Control, *Sulfates, *Reduction (Chemical), Odor, Pipelines, Corrosion, Rusting, Iron, Oxidation, Linings, Sampling, Aeration, Chlorine, Inhibitors, Hydrogen sulfide, Hydrogen ion concentration, Sewage, Nitrogen compounds, Oxidation-reduction potential, Phenols, Copper compounds, Anaerobic.
Identifiers: Tubercle, Desulfovibrio desulfuricans, Reamer, Chromate ion, Cadmium, Zinc, Formaldehyde, Amines.

Although the importance of sulfate-reducing bacteria in the external corrosion of pipelines is well known, their activity inside water mains is often overlooked. Rusty water or offensive odors at isolated points in a distribution system are often attributable to them. A microbiologic investigation was made of tubercles, water mains and the water, confirming that the organism was the specific sulfate-reducing bacterium, Desulfovibrio desulfuricans. This conclusion is consistent with the problem of rusty water accentuated during the warmer months of the year. A series of investigations was conducted to test media and methods for the detection of sulfate-reducing bacteria. Many types of lining compounds have been evaluated and methods of lowering the corrosivity by mechanical or chemical means. Aeration is useful in preventing sulfate-reducing bacterial growth. Tubercles usually form during periods of low oxygen concentration. Maintenance of residual chlorine throughout a distribution system is one of the best preventive measures against the formation of tubercles, which, limited in drinking water supplies, can help prevent corrosion of sewage mains or control odor. (Jones-Wisconsin)
W70-04813

REPORT OF THE SELECT COMMITTEE ON WATER RESOURCES (FLORIDA'S WATER

PROBLEMS).

Florida House of Representatives, Tallahassee, Florida, Oct 1, 1964. 24 p, append.

Descriptors: *Florida, *Legislation, *Water quality, *Water pollution, Standards, Water quality control, Water pollution sources, Administrative agencies, Industrial wastes, Sewage, Sewage treatment, Navigation, Canals, Recreation, Saline water intrusion, Permits, Coasts, Flooding, Flood plains, Drilling, Detergents, Drainage districts, Wells, Water storage.

The Select Committee on Water Resources conducted meetings at various locations around the state in order to familiarize its members with Florida's many water problems. The problems under consideration included: (1) industrial pollution; (2) domestic pollution; (3) deposit of foreign matter in public waters; (4) salt water intrusion; (5) identification and designation of floodplain areas; (6) financing acquisition of water storage lands; (7) licensing of well drillers; (8) hard detergents; and (9) codification of drainage laws. The interest generated at the hearings centered around the general topics of pollution abatement and enforcement and implementation of existing laws. The Committee made various recommendations in each of these areas and proposed legislation to carry out the recommendations. The Committee also suggested that further research be authorized either by a special study group or by an interim committee to report to the next legislature. (See also W70-04882 thru W70-04886). (Dearing-Florida)
W70-04881

REPORT OF THE SELECT COMMITTEE ON WATER RESOURCES (INDUSTRIAL AND DOMESTIC POLLUTION).
Florida House of Representatives, Tallahassee, Florida, Oct 1, 1964, p 6-11.

Descriptors: *Florida, *Industrial wastes, *Domestic wastes, *Water pollution sources, Industries, Chemical wastes, Rivers, Bays, Lakes, Streams, Settling basins, Accidents, Water quality control, Economic impact, Recreation demand, Administrative agencies, Legislation, Sewage treatment, Sewage disposal, Septic tanks, Sanitary engineering, Taxes, Local governments, Sewers.
Identifiers: *Accidental pollution.

Legislatively encouraged industrial expansion and development in Florida has created major problems of disposal of industrial wastes, especially chemical wastes. Substantial quantities of wastes have been accidentally and deliberately emptied into the state's streams, lakes, and bays. There has been some effective local pollution control and several instances of voluntary industrial pollution control. The Committee therefore recommends: (1) major changes in responsibilities of administrative agencies to police industry; (2) adequate staffing or existing enforcement agencies; (3) increased encouragement of industry cooperation; (4) concurrent jurisdiction over water quality control for the Board of Conservation and the Board of Health; and (5) repeal of all local legislation that is inconsistent with the proposed state plan. Domestic pollution is a problem similar in magnitude to industrial pollution. Several municipalities still discharge raw sewage into state waters. Future population expansion will require even more sewage treatment facilities than are presently available. The Committee summarized the findings and recommendations of the Board of Health, and further recommended that any discharge of raw sewage into state waters be prohibited and that regular tax returns be withheld from offending local governments. (See W70-04881). (Dearing-Florida)
W70-04882

REPORT OF THE SELECT COMMITTEE ON WATER RESOURCES (FOREIGN MATTER AND SALT WATER INTRUSION IN PUBLIC WATERS).

Florida House of Representatives, Tallahassee, Florida, Oct 1, 1964, p 12-15.

Descriptors: *Florida, *Domestic wastes, *Saline water intrusion, *Legislation, Navigation, Recreation, Navigable waters, Vessels, Water skiing, Coasts, Water pressure, Drainage, Bays, Canals, Rivers, Dams, Tidal waters, Water wells, Rainfall, Water supply, Administrative agencies, Spillways, Permits, Construction, Public health.
Identifiers: *Saline barrier lines.

Navigation and recreational uses of public waters have suffered from deposits of foreign matter in the waters. Sunken vessels and other debris are unsightly and dangerous to sportsmen and recreationists. The Committee recommends that legislation be passed prohibiting such deposit of any foreign matter into public waters. A further problem affecting water supplies in coastal areas is the intrusion of salt water. The primary factors contributing to this intrusion are: (1) loss of fresh water pressure through increased demands of municipalities, agriculture, and industry; (2) excessive drainage; (3) lack of protective works against tidewaters in bays, canals, and rivers; (4) improper location of water wells; and (5) highly variable annual rainfall with insufficient surface storage during droughts. One method of reducing this intrusion requires the establishing of salt barrier lines along coastal areas. No canals or streams could be constructed or enlarged inland from this line unless structures are installed to prevent salt water from moving inland. The Committee recommends that the Board of Conservation be required to establish these lines and that permits be required before any canal can be constructed or any stream enlarged which would discharge into tidal waters. (See W70-04881). (Dearing-Florida)
W70-04883

REPORT OF THE SELECT COMMITTEE ON WATER RESOURCES, (FLOOD PLAIN AREAS AND WATER STORAGE LANDS).

Florida House of Representatives, Tallahassee, Florida, Oct 1, 1964, p 16-21.

Descriptors: *Florida, *Flood plains, *Water storage, *Legislation, Flooding, Flood protection, Flood forecasting, Flood damage, Flood control, Classification, Administrative agencies, Watersheds, Land use, Government finance, Construction, Water levels, Water supply, Multiple-purpose projects, Construction costs, Project planning, Cost sharing.

There is a need for identification and designation of floodplain areas throughout the state. This would aid prospective land purchasers in selecting property, allow property owners to assess the extent of development that is economically feasible, and aid the landowner in determining the possibility of improvement to prevent or minimize flood damage. The Committee recommends that the Board of Conservation be required to identify and designate such areas which are subject to periodic flooding. The Committee also recommends that adequate funds be secured for the acquisition of water storage lands for several water control projects, especially in the Upper St. Johns River area and the Green Swamp area. Water resources in these areas are being continually diminished and well water levels are being adversely affected. Such water storage areas would help to alleviate this problem and could serve multiple purposes such as recreation and preservation of adequate fresh water supplies. The basic problem in this acquisition of this storage land is the lack of available funds and to this end the Committee recommended several sources for the needed capital. (See W70-04881). (Dearing-Florida)
W70-04884

REPORT OF THE SELECT COMMITTEE ON WATER RESOURCES (WELL DRILLING, HARD DETERGENTS, CODIFICATION OF DRAINAGE LAWS).
Florida House of Representatives, Tallahassee, Florida, Oct 1, 1964, p 22-24

Descriptors: *Florida, *Drilling, *Detergents, *Drainage, Legislation, Permits, Wells, Well regulation, Administrative agencies, Subsurface waters, Water conservation, Local governments, Foaming, Water pollution sources, Industrial production, Alkylbenzene sulfonates, Chemicals, Soaps, Drainage districts, Sewerage, Taxes, Compensation, Rivers.
Identifiers: *Esthetic effects, Hard detergents.

Water waste from improper well construction is a basic conservation problem. To help alleviate this situation the Committee recommends that all well drillers in the state be subject to licensing by a state agency and that the Board of Conservation establish statewide drilling standards adaptable to each county's own particular needs and problems. Another water problem arises from the presence of hard detergents (alkyl benzene sulfonate) in state water supplies as evidenced by the presence of foam in rivers, sewage and water treatment plants. While these detergents present no immediate threat to public health, the esthetic effects they produce are of considerable importance to the state. The detergent industries are responding by substituting some soft detergents for the undesirable hard detergents, but legislation is needed to completely ban the sale of hard detergents within the state. The Committee also recommends revision and recodification of the presently inadequate drainage laws. The proposed revision would give drainage districts authority to construct roadways and water and sewage systems. This revision would also remedy present problems of inadequate organization, procedure, compensation, taxing and bonding powers, and excessive tax penalties. (See W70 04881). (Dearing-Florida)
W70-04885

REPORT OF THE SELECT COMMITTEE ON WATER RESOURCES (PROPOSED STATUTES).

Florida House of Representatives, Tallahassee, Florida, Oct 1, 1964, Appendix.

Descriptors: *Florida, *Legislation, *Water quality, *Water pollution, Water quality control, Standards, Water pollution sources, Administrative agencies, Industrial wastes, Sewage, Sewage treatment, Navigation, Recreation, Saline water intrusion, Permits, Canals, Coasts, Flooding, Flood plains, Drilling, Detergents, Drainage districts, Wells, Water storage.

Based on the foregoing study, the Committee recommends enactment of legislation to: (1) authorize the Conservation Board to establish and enforce water quality standards and to make it unlawful to discharge any pollutants into state waters in violation of the water quality standards; (2) repeal local legislation giving immunity to industrial polluters inconsistent with the proposed water quality control; (3) prohibit the discharge of untreated sewage into state waters; (4) prohibit such discharge of foreign matter into state waters as interferes with navigation and maximum recreational use of public waters; (5) authorize the Conservation Board to establish a state-wide salt water barrier line, and require permits for canal construction or enlargement of natural watercourses in coastal areas; (6) authorize the Conservation Board to identify and designate those areas subject to periodic flooding and considered to be floodplain, swamp, or overflow lands; (7) require the licensing of well drillers, and authorize the Conservation Board to adopt drilling regulations; (8) prohibit the sale, use, manufacture, or possession of hard detergents in Florida; (9) revise drainage district legislation; and (10) appropriate funds for water storage lands especially in the Upper St. Johns River and Green Swamp projects. (See W70-04881) (Dearing-Florida)

W70-04886

OUR NAVIGABLE WATERS -- POLLUTED AND OTHERWISE,
Coast Guard, Washington, D.C. Maritime Pollution Control Branch.
Charles W. Koburger, Jr.
Naval War College Review, p 51-58, October 1969. 1 fig.

Descriptors: *Water pollution control, *Waste water treatment, *Oil, *Accidents, *Federal Government, Water utilization, Coast Guard regulations, Boats, Ships, Disasters, Equipment, Planning.
Identifiers: *National Multi-agency Oil and Hazardous Materials Contingency Plan, *On-scene commander, Spill response, Containment, Countermeasures, Cleanup.

Of interest to laymen, students, and professionals alike, this general survey examines the various aspects of the pollution problem in our navigable waters. Examined also are the measures that can be taken to control it, ashore and afloat. It is concluded that, by wisely employing the measures of control we now have and are acquiring, it should be possible to produce a noticeable improvement in our waterways in the near future. Included are two diagrammatic presentations of the various marine pollution disaster control measures and of their relative sequential priority.
W70-04887

CHEMICAL STABILIZATION OF THE URANIUM TAILINGS AT TUBA CITY, ARIZONA,
Bureau of Mines, Salt Lake City, Utah. Salt Lake City Metallurgy Research Center.
Richard Havens, and Karl C. Dean.
BuMines Rept. of Inv. 7288, August 1969. 12 p.

Descriptors: *Arizona, *Stabilization, Encrustation, *Sealant, Sulfonates, Polymers, Sprinkling, Uranium.
Identifiers: *Erosion control, Slope stabilization, Air pollution, Arid land, *Tuba City.

Acidic and basic uranium leach plant residues located on the Navajo Indian Reservation, Tuba City, Ariz., were successfully stabilized against wind erosion using a relatively low-cost chemical method. An elastomeric polymer chemical was applied to the dike areas and a calcium magnesium lignosulfonate to the beach areas of three tailings ponds. The water-soluble chemicals were applied with an automated sprinkling system. The stabilization cost was $335 per acre for the 34.5-acre tract.
W70-04888

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

AN EVALUATION OF THE DECISION PROCESS IN WATER RESOURCE PROJECT DESIGN,
Stanford Univ., Calif. Dept. of Civil Engineering.
Ray K. Linsley, Stephen J. Burges, and Peter W. Whitford.
Available from the Clearinghouse as PB-190 194, $3.00 in paper copy, $0.65 in microfiche. Stanford, California, Department of Civil Engineering, Technical Report No. 122, Dec. 1969. 76p, 31 fig, 3 tab, 37 ref. OWRR 14-01-0001-1968, OWRR Project C-1321 (1968).

Descriptors: *Decision making, *Planning, Hydrology, Methodology, Reservoir design, Risks, Water utilization, Water supply, Flood control.

Results are presented of exploratory attempts to construct the flow of decisions and data into the design of single purpose water supply and flood control projects. Estimates of uncertainty in each of the data inputs and in each calculation in the analysis were made and a distribution of error in the final project cost or benefit-cost ratio determined. Because of scarcity of data on the magnitude of individual uncertainties most values were estimated on the basis of judgment. The results suggest the possibility of a substantial uncertainty in the ultimate values and indicated that a more thorough investigation of individual components of uncertainty was warrented. The report contains a fairly extensive analysis of the probability characteristics of damage estimates in flood control planning based on the work of James, Benson, and Homan and Waybur. The problem of forecasting water demand for urban requirements is reviewed and some of the problems involved in making these forecasts are discussed. A study was made of hydrologic procedures and their influence on the uncertainty in estimating a required reservoir capacity. The report examines stochastic methods and results obtained suggest that for arid regions very long records of observed streamflow are necessary to properly identify statistical parameters and very long stochastic simulation periods are needed to define a stable distribution of storage requirements.
W70-04544

MODELING THE RUNOFF CHARACTERISTICS OF AN URBAN WATERSHED BY MEANS OF AN ANALOG COMPUTER,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 04C.
W70-04575

BIG BLUE RIVER BASIN.
Nebraska Soil and Water Conservation Commission, Lincoln.
For primary bibliographic entry see Field 02E.
W70-04603

EFFECTS OF WATERSHED CHANGES ON STREAMFLOW,
Texas Univ., Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 04C.
W70-04723

APPLICATION OF CONTINUOUS ACCOUNTING TECHNIQUES TO EVALUATE THE EFFECTS OF SMALL STRUCTURES ON MUKEWATER CREEK, TEXAS,
Texas Univ., Austin, and Texas Tech Univ., Lubbock.
For primary bibliographic entry see Field 04C.
W70-04726

POTENTIAL OF PHYSICAL MODELS FOR ACHIEVING BETTER UNDERSTANDING AND EVALUATION OF WATERSHED CHANGES,
Massachusetts Inst. of Tech., Cambridge.
For primary bibliographic entry see Field 02A.
W70-04729

QUEUING THEORY AND MULTIPLE-PURPOSE RESERVOIR DESIGN,
Institut fuer Wasserwirtschaft, Berlin (East Germany).
For primary bibliographic entry see Field 04A.
W70-04748

CERTAINTY OF STREAM-FLOW CONTROL WITHIN A LIMITED PERIOD OF TIME,
Toronto Univ., (Ontario). Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 04A.
W70-04749

SYSTEMS SIMULATION FOR REGIONAL ANALYSIS,
Battelle Memorial Inst., Columbus, Ohio; Indiana Univ., Bloomington; Massachusetts Inst. of Tech., Cambridge; and Chicago Univ., Ill.
H. R. Hamilton, S. E. Goldstone, J. W. Milliman, A. L. Pugh, III, AND E. G. Roberts.
Cambridge, Massachusetts, The M.I.T. Press, 1969, 275 p, 57 fig, 52 tab, 1 chart, 158 ref, 4 append.

Descriptors: *Simulation analysis, *Methodology, Computer models, Regional analysis, Computer models, Mathematical models, Management, Decision making, Dynamic programming, Human population, Economic life, Water demand, Water quality, Water supply.
Identifiers: *Susquehanna River Basin, Social sciences, Regional goals, National goals, State of the art, Demographic variables, Employment variables, Water variables.

The book has thirteen chapters. Chapter I introduces the book. Chapter II discusses the problems surrounding model-building research in the social sciences in general and in economics in particular. Chapter III reviews the state of the art in regional economic analysis. Chapter IV compares the Susquehanna model to other regional-economic and river-basin models. Chapter V discusses the philosophy and methodology of approach of the Susquehanna model. Chapter VI describes the methodology for devising economic sub-regions within the basin, and discusses economic and population variables among the sub-regions. Chapter VII gives a brief overview of the model. Chapters VIII-XI discusses individual sectors of the model, the demographic sector, the employment sector, and the water sector. The employment sector takes two chapters: Chapter IX presents the basis for sectoring the employment structure and for identifying endogenous and exogenous forces shaping the regional economy; Chapter X concentrates on export industries. Chapter XII describes several model simulations and suggests model refinements. Chapter XIII summarizes some of the lessons learned during the research. The chapter emphasizes the value of a 'balanced and iterative' research strategy. (See also W70-04836 thru W70-04845). (Gossen-Chicago)
W70-04835

CHAPTER I: INTRODUCTION AND SUMMARY,
Battelle Memorial Inst., Columbus, Ohio; Indiana Univ., Bloomington; Massachusetts Inst. of Tech., Cambridge; and Chicago Univ., Ill.
H. R. Hamilton, S. E. Goldstone, J. W. Milliman, A. L. Pugh, III, and E. B. Roberts.
In: Systems Simulation for Regional Analysis. Cambridge, Massachusetts: The M.I.T. Press, 1969, pp 1-15, 1 fig.

Descriptors: *Simulation analysis, *Methodology, Economics, Computer models, Regional analysis.
Identifiers: *Susquehanna River Basin.

Chapter I is divided into four sections. Section I describes the research problem and how it was approached. The initial problem was to analyze the economy of the Susquehanna River Basin, to define the role of water resources in this economy, and to develop improved techniques for accomplishing this type of analysis. The research program was carried out in three major steps: (1) problem definition and technique selection; (2) model development; and (3) model refinement. The section describes the effectiveness of computer application. It should be used to generate different sets of projections under alternative assumptions regarding data and functional relationships. Section II describes peculiarities of the Susquehanna River Basin economy and of the Susquehanna model. Section III outlines the book. Section IV emphasizes that the Susquehanna model is not a 'general' regional model. Each separate region has a specific set of demands, and so requires an individual model. However, the Susquehanna model represents a significant advancement in the state of the art by typing together the employment, demographic, and water sectors of a large region in one model. (See W70-04835). (Gossen-Chicago)
W70-04836

CHAPTER II: PERSPECTIVES ON MATHEMATICAL MODELS IN THE SOCIAL SCIENCES,
Battelle Memorial Inst., Columbus, Ohio; Indiana Univ., Bloomington; Massachusetts Inst. of Tech., Cambridge; and Chicago Univ., Ill.
H. R. Hamilton, S. E. Goldstone, J. W. Milliman, A. L. Pugh, III, and E. B. Roberts.
In: Systems Simulation for Regional Analysis. Cambridge, Massachusetts: The M.I.T. Press, 1969, pp 16-33, 42 ref.

Descriptors: *Mathematical models, *Economics, Methodology, History.
Identifiers: *Social sciences, Tinbergen, Haavlemo, Cowles Commission, Research.

The purpose of Chapter II is to explicate issues surrounding the role of mathematical models in the social sciences. Section I focuses on social sciences in general. It maintains that the use of mathematical models is a key element in the scientific method, both in the natural sciences and in the social sciences. Issues regarding the appropriateness of mathematical models to the social sciences are discussed. Section II focuses on economics. It outlines a history of the use of mathematical models in economics. Empirically implemented mathematical economic models were a twentieth-century development. The work of Tinbergen, Haavlemo, and the Cowles Commission is described, and criticisms to their work are discussed. Subsequent efforts to resolve these problems are discussed. Results of these efforts include: (1) tremendous growth in the volume and quality of empirical work; (2) a new set of techniques for estimating parameters of models; (3) significant contributions toward the use of models for policy purposes; (4) work on checking the accuracy of forecasts yielded by economic models; and (5) progress in the study of the dynamic properties of economic models. Model building is an important subject that has received little attention. (See W70-04835). (Gossen-Chicago)
W70-04837

CHAPTER III: REGIONAL ECONOMIC ANALYSIS AND RIVER BASIN PLANNING,
Battelle Memorial Inst., Columbus, Ohio; Indiana Univ., Bloomington; Massachusetts Inst. of Tech., Cambridge; and Chicago Univ., Ill.
H. R. Hamilton, S. E. Goldstone, J. W. Milliman, A. L. Pugh, III, and E. B. Roberts.
In: Systems Simulation for Regional Analysis. Cambridge, Massachusetts, The M.I.T. Press, 1969, pp 34-53, 13 ref.

Descriptors: *Economics, *Regional analysis, Income analysis, Computer models, Institutional constraints, Water law, Third party effects, Management, Decision making.
Identifiers: *River basin planning, Regional goals, National goals, Market economy.

Chapter III purposes to show the interrelationships between regional economic analysis and river basin planning. Section I describes the nature of regional analysis. Section II describes the difficulties of regional analysis, most of which arise because theories of regional income generation are insufficiently developed. Difficulties include: defining regions; collecting data; and identifying income generated within a region. Section III discussed three problems of specifying goals for regional planning: (1) many conflicting regional goals may exist; (2) various groups may not agree on the ranking of goals; and (3) regional goals may not reflect optimal development for the nation. Particular goals are related to particular economic models for projecting future economic activity. Section IV addresses problems of relating regional development to the existing institutional framework, and Section V discusses the design of more efficient institutions. The current poor management of water resources has two causes: (1) existing water laws disregard obvious externalities; and (2) the operation of water law prevents development of a market system which might facilitate transfer of water to new uses in response to changing economic relationships. Different regions will require different institutional combinations of centralized decision making and use of the market. (See W70-04835) (Gossen-Chicago)
W70-04838

CHAPTER IV: CONTEMPORARY REGIONAL PROJECTION MODELS,
Battelle Memorial Inst., Columbus, Ohio; Indiana Univ., Bloomington; Massachusetts Inst. of Tech., Cambridge; and Chicago Univ., Ill.
H. R. Hamilton, S. E. Goldstone, J. W. Milliman, A. L. Pugh, III, and E. G. Roberts.
In: Systems Simulation for Regional Analysis. Cambridge, Massachusetts: The M.I.T. Press, 1969, p 54-87, 36 ref.

Descriptors: *Computer models, Economic prediction.
Identifiers: State of the art, New York Metropolitan Region Study, Upper Midwest Economic Study, Ohio River Basin Study, California Development model, Oahu model, Lehigh Basin model, Susquehanna River Basin Studies.

After briefly discussing the general nature of regional economic projections, the chapter discusses six regional models to illustrate the current state of the art. The models discussed are: (1) the New York Metropolitan Region Study; (2) the Upper Midwest Economic Study; (3) the Ohio River Basin Study; (4) the California Development model; (5) the Oahu, Hawaii model; and (6) the Lehigh Basin simulation model. The National Planning Association's study of the Susquehanna River Basin is briefly discussed. These models offer a perspective for discussion of the Battelle Memorial Institute's Susquehanna model in subsequent chapters. There are four major differences between the Susquehanna model and the other models discussed. The Susquehanna model: (1) combines the demographic and economic sectors in one model; (2) is of a simulation type that makes it possible to insert a wide variety of assumptions and parameters and to employ sensitivity analysis; (3) is of a dynamic type, which allows explicit feedbacks and lagged variables within and between sectors; and (4) is the only model to combine the economic and water sectors. (See W70-04835). (Gossen-Chicago)
W70-04839

CHAPTER V: PHILOSOPHY AND METHODOLOGY OF APPROACH,
Battelle Memorial Inst., Columbus, Ohio; Indiana Univ., Bloomington; Massachusetts Inst. of Tech., Cambridge; and Chicago Univ., Ill.
H. R. Hamilton, S. E. Goldstone, J. W. Milliman, A. L. Pugh, III, and E. B. Roberts.
In: Systems Simulation for Regional Analysis. Cambridge, Massachusetts: The M.I.T. Press, 1969, p 88-114, 9 fig, 1 tab, 1 chart, 17 ref.

Descriptors: *Methodology, Regional analysis, Dynamic programming, Simulation analysis, Model studies.
Identifiers: Susquehanna River Basin, Feedback relationships, Continuous simulation, DYNAMO.

Chapter V describes how the general considerations of regional economic analysis and the particular objectives of the Susquehanna study led to the selection of the particular mathematical approach. Problem characteristics arising in regional analysis usually demand methodologies that: (1) contain the capacity to treat a large number of variables; (2) have the flexibility for handling wide variations in data types and functional relationships; (3) are oriented toward dynamic considerations including consideration of time-varying factors; and (4) permit inclusion of feedback relationships. Nonquantitative and quantitative methods of regional analysis are discussed. Simulation methods offer significant advantages: (1) simulation can be inexpensive; (2) minor changes can be easily made; (3) the model is not restricted to linear formations; and (4) the model can contain many variables. Of the three types of simulation, continuous simulation was chosen for the Susquehanna problem because costs were reasonable, numerical methods for approximating simultaneous differential equations were developed, and a computer program, called DYNAMO, was available. The specific methodology has four steps (1) problem definition, (2) model construction; (3) model simulation; and (4) model validation. Each step is fully described. Discussion is illustrated by the step-by-step development of a simply, hypothetical regional model. (See W70-04835). (Gossen-Chicago)
W70-04840

CHAPTER VI: THE REGIONAL SETTING OF THE STUDY,
Battelle Memorial Inst., Columbus, Ohio; Indiana Univ., Bloomington; Massachusetts Inst. of Tech., Cambridge; and Chicago Univ., Ill.
H. R. Hamilton, S. E. Goldstone, J. W. Milliman, A. L. Pugh, III, and E. B. Roberts.
In: Systems Simulation for Regional Analysis. Cambridge, Massachusetts: The M.I.T. Press, 1969, p 115-124, 1 fig, 6 tab, 2 ref.

Descriptors: *Methodology, Regional analysis, Human population, Economic life, Water demand.
Identifiers: *Susquehanna drainage basin, Economic autonomy, Economic development.

Chapter VI describes the Susquehanna River and the economy of its drainage basin. The study area was delimited by the hydrologic entity, regional economic considerations, and data considerations. Because of these factors, the study area selected was composed of whole county units. Division of the area into subregions was necessary for two reasons: (1) the various economics within the study area were developing at grossly different rates; (2) subregionalization was the first step in localizing water needs. Subregions were drawn within the context of defined labor markets and retail and wholesale trading areas. Subregions were selected that minimized commuting from one subregion to another, in order to define subregions with minimum of economic interdependence. There are eight subregions: Elmira; Binghamton; Williamsport; Sunbury; Wilkes-Barre-Scranton; Altoona; Harrisburg; and Baltimore. Each of these includes several counties. The final section of the chapter compares economic and population variables of the subregions. (See W70-04835). (Gossen-Chicago)
W70-04841

CHAPTER VII: AN OVERVIEW OF THE MODEL,
Battelle Memorial Inst., Columbus, Ohio; Indiana Univ., Bloomington; Massachusetts Inst. of Tech., Cambridge; and Chicago Univ., Ill.
H. R. Hamilton, S. E. Goldstone, J. W. Milliman, A. L. Pugh, III, and E. B. Roberts.
In: Systems Simulation for Regional Analysis. Cambridge, Massachusetts: The M.I.T. Press, 1969, p. 125-132, 5 fig.

Descriptors: *Methodology, *Computer models, Human population, Labor supply, Unemployment, Migration patterns, Water quality, Water supply, Regional analysis.
Identifiers: Susquehanna drainage basin, Demographic variables, Employment variables, Water variables, Feedback effects, Low-flow measurement, Model output.

Chapter VII summarizes the model's major sectors. The Susquehanna model contains models of each of the economic subregions. These subregional models are composed of three major sectors: demographic and employment sectors are related by a feedback loop including population, laborforce, unemployment and migration variables. Section I discusses the demographic sector. Three factors--births, deaths, and migration--are involved directly in population change, migration being the most dynamic. In this model, migration ties together the demographic and employment sectors. Section II discusses the employment sector. There

are three employment categories: export industries; wholesalers; and retailers. The driving force of the model is Market Area Demand operating through export industry employment. Section III discusses the water sector. Specific locations with existing or possible water problems were analyzed for quality and quantity with a simple, hydrological low-flow model. The water sector ties together all the subregions, with regard to changes in water quantity and quality. It also tests the potential effects of constructing dams and reservoirs. Section IV briefly discusses model output. General principles for plotting variables are given. (See W70-04835). (Gosseen-Chicago)
W70-04842

CHAPTER XI: THE WATER SECTOR,
Battelle Memorial Inst., Columbus, Ohio; Indiana Univ., Bloomington; Massachusetts Inst. of Tech., Cambridge; and Chicago Univ., Ill.
H. R. Hamilton, S. E. Goldstone, J. W. Milliman, A. L. Pugh, III, and E. B. Roberts.
In: Systems Simulation for Regional Analysis. Cambridge, Massachusetts: The M.I.T. Press, 1969, p 206-233, 8 fig, 4 tab, 19 ref.

Descriptors: *Methodology, *Computer models, Water quality, Water supply, Regional analysis, Simulation analysis, Flood control, Acid mine water, Hydroelectric power, Navigation, Irrigation, Water works, Dissolved oxygen, Recreation, Economic impact, Forest management.
Identifiers: *Susquehanna drainage basin.

The water sector is viewed as a 'technical sector' that is appended to a more general regional simulation model. This sector could be replaced or augmented by other technical factors peculiar to another region. Section I, focusing on methodology, discusses: the separation of the water problem into quality and quantity considerations; the choice of problem areas for analysis; the mechanics of river simulation; and water variables excluded from the model. Water variables excluded are flood control, acid mine drainage, hydropower production, navigation, and irrigation, each of which are discussed. Section II focuses on general water quality and quantity considerations. Use of the water sector allows assessment of important aspects of works construction in relation to dissolved oxygen levels, water quantity, the economic impact of recreation, and the economic impact of the construction of the works themselves. Impact of water on economic development is negligible. Only locations with possible water problems are considered in the model. This approach is practical to study a given basin; it is not intended to provide a general model. Section III discussed forest management to illustrate the dynamics of other kinds of technical sectors. (See W70-04835). (Davis-Chicago)
W70-04843

CHAPTER XIII: IMPLICATIONS OF THE MODEL-BUILDING EFFORT FOR FUTURE RESEARCH,
Battelle Memorial Inst., Columbus, Ohio; Indiana Univ., Bloomington; Massachusetts Inst. of Tech., Cambridge; and Chicago Univ., Ill.
H. R. Hamilton, S. E. Goldstone, J. W. Milliman, A. L. Pugh, III, and E. B. Roberts.
In: Systems Simulation for Regional Analysis. Cambridge, Massachusetts: The M.I.T. Press, 1969, p. 258-275, 1 fig, 7 ref.

Descriptors: *Methodology, Feasibility studies, Model studies, Simulation analysis, Data collections, Statistical models, Mathematics, Dynamic programming, Mathematical models, Data processing, Regional analysis, Computer models.
Identifiers: *Research needs, Susquehanna model, Objectives, Multidisciplinary approach, Iterative research strategy, Alternative methodologies, Operational models, Disaggregation, Public use, Private use.

Section I presents principles which emerged from the Susquehanna regional model-building effort. Planning a model requires clearly stated objectives, a multidisciplinary approach, and an iterative research strategy, which is described extensively. After agreeing on objectives, researchers should undertake an exploratory study to determine the feasibility of the research effort, compare alternative methodologies, and explicate the nature and availability of needed inputs. The second phase involves construction of an initial model. Phase three involves repeated computer simulation testing and reformulating of the initial model. A comparison with other model-building approaches shows that few efforts have employed an interative research strategy. Many models have been built without computer simulation experiments, with too much dependence on one set of data, or with an overemphasis on statistical criteria. Section II summarizes salient features of the Susquehanna model and suggests areas for additional research. The model: (1) is a mathematical model; (2) is an operational model; (3) is data based; (4) provides great detail by disaggregation; (5) incorporates significant advances in formulating the demographic sector; (6) generates outputs relating to water quantity and quality for various points on the river; and (7) illustrates how the computer has affected social scientific research. Section III describes future uses of regional simulation models, including public policy uses and private uses. (See W70-04835). (Gossen-Chicago)
W70-04844

APPENDIX A: THE MANAGEMENT OF A MULTIDISCIPLINARY RESEARCH PROJECT,
Battelle Memorial Inst., Columbus, Ohio; Indiana Univ., Bloomington; Massachusetts Inst. of Tech., Cambridge; and Chicago Univ., Ill.
H. R. Hamilton, S. E. Goldstone, J. W. Milliman, A. L. Pugh, III, and E. B. Roberts.
In: Systems Simulation for Regional Analysis. Cambridge, Massachusetts: The M.I.T. Press, 1969, p. 276-288, 1 fig, 1 ref.

Descriptors: *Personnel management, *Methodology, Project planning, Professional personnel, Scientific personnel, Psychological aspects, Simulation analysis, Model studies.
Identifiers: Multidisciplinary studies, Small projects, Accounting system.

This appendix emphasizes that management is necessary to integrate even highly competent individuals into an effective research team. The management role in multidisciplinary studies is often ignored because small project coordinators usually have less interest in project management per se than in emphasizing their research specialties. In small studies, problems of the project coordinator most often involve personal characteristics of team members. Some must be urged to communicate with other project staff; others must be restrained from overcommunicating. In modeling studies, the major goal should be to study the problem by constructing a balanced model. To do so, the manager must be flexible enough to reassign people among tasks and to alter the research team. A good accounting system is about the only management aid a small-project manager has. He can devise other aids on an ad hoc basis. Because so much research is carried out by small groups, more attention should be given to management of such studies and to providing directors of this research with better tools for achieving high research efficiency. (See W70-04835). (Gossen-Chicago)
W70-04845

WATER RESOURCES SYSTEMS ANALYSIS--AN OVERVIEW,
Battelle Memorial Inst., Columbus, Ohio.
Neil L. Drobny.
American Water Resources Association, Proceedings of the Fourth American Water Resources Conference, November 18-22, 1968. p 534-555, 3 fig, 1 tab, 45 ref.

Descriptors: *Systems analysis, *Methodology, *Decision making, *Mathematical models, Linear programming, Dynamic programming, Stochastic processes, Queueing theory, Simulation analysis, Model studies, Markov processes, Statistical models.
Identifiers: *Policy, Nonlinear programming, Statistical decision theory, Inventory theory.

In the context of this paper, systems analysis refers to a strategy for problem solving which relies heavily on mathematical modeling to assess the technical and economic optimality of alternative system designs, policies and operating procedures for performing various functions and meeting various needs with limited resources. It is important to keep in mind that systems analysis per se does not provide these assessments which also must incorporate professional, legal, political and social considerations. Rather, systems analysis may be employed as a decision aid in assessing the technical and economic consequences of alternative courses of action. Systems analysis techniques have several advantages over traditional methods of design and analysis: (1) systems analysis techniques provide for a more effective union of engineering and economic considerations into the problem formulation and solution procedure; and (2) systems analysis also provides a means for incorporating considerations relating to risk and uncertainty. The following techniques are discussed: (1) optimization programming models; linear programming, nonlinear programming and dynamic programming; (2) stochastic models; statistical decision theory, queueing theory, inventory theory, and markov processes; and (3) simulation models. Limitations on the application of systems analysis to problems in water resources are discussed and viewed as being of two types--data limitations and conceptual limitations. (Davis-Chicago)
W70-04900

WATER SYSTEMS MODELING,
Illinois Univ., Urbana.
Dale D. Meredith.
In: Appendix C of 'Analysis of Water and Water-Related Research Requirements in the Great Lakes Region' Council on Economic Growth, Technology, and Public Policy of the Committee on Institutional Cooperation, June 1968. 17 p, 30 ref, p 61-77.

Descriptors: *Mathematical models, *Model studies, *Great Lakes, Methodology, Great Lakes region, Hydrologic model, Simulation, Systems analysis.

This article maintains that a systems model of the Great Lakes area can be developed. After a thorough review of contemporary attempts at model development, for both systems and subsystems; two basic approaches to a complete system model are discussed, a complete computer simulation and a gaming-situation. The following method in developing a Great Lakes System model is outlined: (1) define questions to be answered by the model, (2) make a 'rough cut' of the model and determine the relevant subsystems to be included, (3) examine the subsystems to determine the areas of the model which are well defined and those which are least well defined, (4) give highest priority for research to those areas of greatest weakness in the model, and (5) maintain a series of working conferences which meet periodically to keep the focus on the overall model and its development. This step is important in that it enables the researchers in the various disciplines to see where their work fits into the model and also to see the kinds of results they need to make their work compatible with the information needed by the model. This model could be modular, so that different sectors could proceed at different rates of development, the critical factor being that the various models must eventually be compatible. The above procedure could be used for either a model of the entire Great Lakes area or for a subregion. (Davis-Chicago)
W70-04901

OPTIMUM WATER USE - A MULTIDISCIPLINARY APPROACH,
North Carolina Univ., Chapel Hill.
Jabbar K. Sherwani.
Multidisciplinary Research As An Aid To Public Policy Formation, Virginia Polytechnic Institute, Blacksbury, p 1-19, December 8 1965. 19 p, 3 ref.

Descriptors: *Optimization, *Water utilization, *Mathematical models, *Simulation analysis, *Input-output analysis, Public benefits, Decision making, Investment, Regional analysis.
Identifiers: Public policy.

Optimum water use in a regional setting was discussed and a multidisciplinary water utilization plan was presented. The plan was based on an optimizing approach to public policy making. Water policy problems were split into two groups: those relating to public investment in water projects and those regulating the decision making process of self-supplied water firms. Optimum water use could not be determined in isolation. Cooperative research between engineers and economists was needed to establish the structural parameters involved in alternative uses which governed the direction of water use. Mathematical models for determining the optimum use of water were recommended. Input-output models, programming techniques, and simulation models were discussed and recommended. It was contended, however, that quantitative models were only indicative of the optimum direction for public policy: necessary but not sufficient. The implementation of these models is in the sphere of the political process. (Thiuri-Cornell)
W70-04986

MARKOV MODELS FOR FLOW REGULATION,
Cornell Univ., Ithaca, N.Y. School of Civil Engineering.
Moshe Gablinger, and Daniel P. Loucks.
Journal of the Hydraulics Division, Proceedings of ASCE, Vol 96, No HY1, p 165-181, January 1970. 17 p, 1 fig, 5 tab, 14 ref, 2 append.

Descriptors: *Markov processes, *Linear programming, *Dynamic programming, *Flow measurement, *Flow control, Reservoirs, Numerical analysis, Efficiencies, Economics, Multiple-purpose reservoirs, Models.
Identifiers: Alternative policies.

The problem of defining alternative operative policies for a single multipurpose reservoir was examined through the use of several pairs of discrete stochastic linear and dynamic programming models. The net flows into the reservoir were assumed to be serially correlated, their probabilistic sequence defined by first order Markov chains. Each linear programming model was shown to correspond to a dynamic programming model. The solutions and computational efficiencies of each of the models were compared using a simplified numerical example based on an actual reservoir operating problem. Although the policies obtained from each pair of corresponding models were identical, the time required to solve the dynamic programming models was less than that required for the linear programming models. However, for reservoir problems that were not too large, it was indicated that it might be more economical to use linear programming. (Thiuri-Cornell)
W70-04987

INTEGRATING REGIONAL WATER AND POWER SYSTEMS,
Harvard Univ., Cambridge, Mass. Harvard Development Advisory Service.
Henry D. Jacoby.
Regional Science Association Papers, Vol 21, p 125-137, November 1967. 13 p, 1 fig, 10 ref.

Descriptors: *Water resources, *Power system operations, *Simulation analysis, *Hydroelectric power, *Decision making, Planning, Investment, Marketing, Computers.
Identifiers: Power interconnections, Models.

A mathematical model was developed and applied to an interconnection of independent regional power utilities. A simulation model was developed to assist in making decisions on investment selections, operating policies, and pricing arrangements. Interconnections between three major cities in Colombia - Bogota, Medellin and Cali - were chosen to illustrate the use of the model. The planning method presented involved the use of digital computer simulation as a tool for analyzing potential investment in generation facilities in each of several electric power markets, for evaluating connections among markets, and for studying alternative schemes for operating such interdependent systems. The model made it possible to analyze a large number of alternative investment schemes and operating policies with relative ease and in a small amount of time. (Thiuri-Cornell)
W70-04988

PROBABILITY THEORY AS AN AID TO RESEARCH PLANNING,
Wisconsin Univ., Madison. Dept. of Civil Engineering.
Paul M. Berthouex.
Journal, Amer Water Works Association, Vol 61, No 12, p 652-658, December 1969. 7 p, 6 fig, 4 tab, 9 ref.

Descriptors: *Probability, *Risks, *Decision making, *Pilot plants, *Design, Technical feasibility, Filtration, Networks, Cost analysis, Economics, Oxidation, Iron.

Probability theory was used to solve a complex network problem and to evaluate various pilot water treatment plant alternatives under uncertainty. The purpose of the pilot water treatment plant study was to reduce technical and economic risks in design, and to provide data useful for scaling up to plants of commercial size. A treatment plant using iron removed by oxidation and rapid sand filtration was used as an example. Network cost analysis was recommended for situations when the probability of getting an acceptable process was low. The probability distribution of obtaining an acceptable outcome was shown for the pilot project example. (Thiuri-Cornell)
W70-04989

DIGITAL SIMULATION TECHNIQUES IN POWER SYSTEM PLANNING,
Norwegian Water Resources and Electricity Board, Oslo.
Vidkunn Hveding.
Economics of Planning, Vol 8, No 1-2, p 118-139, 1968. 22 p, 10 fig.

Descriptors: *Simulation analysis, *Hydroelectric power, *Planning, *Power system operation, *Demand, Storage capacity, Benefits, Efficiencies, Computers, Irrigation, Thermal power, Reservoirs, River systems, Model studies.
Identifiers: Huita-Thjoysa River.

Single plant and multiple plant simulation models were developed for the purpose of planning water reservoirs to provide hydroelectric power. The operational objective was to divide total load at any given moment among the existing units so as to maximize overall efficiency. The planning objective was to provide, in addition to sufficient plant capacity, storage facilities that would maximize total benefits from the system. A demand function for power was developed and various expansion alternatives to meet this demand by a single plant or by multiple plants were compared. The effect of adding a thermal power plant to the hydropower system was applied to the Huita-Thjoysa river system in the operation of the model. It was suggested that the model could also be applied to irrigation allocation problems. (Thiuri-Cornell)
W70-04991

A DYNAMIC MODEL OF THE ECONOMY OF THE SUSQUEHANNA RIVER BASIN,
Battelle Memorial Inst., Columbus, Ohio.
For primary bibliographic entry see Field 04A.
W70-04992

PROBABILISTIC RESERVOIR DESIGN,
Lancaster Univ., Bailrigg (England) Dept of Mathematics.
For primary bibliographic entry see Field 04A.
W70-05031

6B. Evaluation Process

AN EVALUATION OF THE DECISION PROCESS IN WATER RESOURCE PROJECT DESIGN,
Stanford Univ., Calif. Dept. of Civil Engineering.
For primary bibliographic entry see Field 06A.
W70-04544

REGIONAL INTEGRATION OF SURFACE AND GROUNDWATER RESOURCES,
California State Dept. of Water Resources, Los Angeles.
For primary bibliographic entry see Field 04B.
W70-04604

ECONOMICS OF ARTIFICIAL RECHARGE FOR MUNICIPAL WATER SUPPLY,
Resources for the Future, Inc., Washington, D.C.
For primary bibliographic entry see Field 04B.
W70-04614

IRRIGATION IN THE TEXAS HIGH PLAINS AND THE TEXAS WATER PLAN,
Texas Tech Univ., Lubbock.
For primary bibliographic entry see Field 03F.
W70-04618

FRESH WATER SUPPLIES THROUGH DESALINATION,
Department of the Interior, Washington, D.C.
For primary bibliographic entry see Field 03A.
W70-04647

THE ECONOMICS OF URBAN SEWAGE DISPOSAL,
California Univ., Riverside. Dept. of Economics.
For primary bibliographic entry see Field 05D.
W70-04648

ECONOMIC ASPECTS OF GROUND-WATER BASIN CONTROL,
Louisiana Water Resources Research Inst., Baton Rouge.
For primary bibliographic entry see Field 04B.
W70-04650

COMPLEMENTARY-COMPETITIVE ASPECTS OF WATER STORAGE (An Engineering-Economic Approach to Evaluate the Extent and Magnitude of the Complementary and Competitive Aspects of Water Storage for Water Quality Control),
Sacramento State Coll., Calif. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05G.
W70-04653

WATER QUALITY AND VALUE OF HOMESITES ON THE ROCKAWAY RIVER, N.J.,
Rutgers - The State Univ., New Brunswick, N.J. Water Resources Research Inst.
Jacquelyn L. Beyer.
Available from the Clearinghouse as PB-190 273, $3.00 in paper copy, $0.65 in microfiche. New Jersey Water Resources Research Institute, Progress Report, Rutgers University, December 1969. 20 p, 2 tab, 1 fig. OWRR Project A-024-NJ.

Descriptors: *Water quality, *Environment, *Environmental effects, Behavior, Social aspects, Economics.
Identifiers: *Residential location desirous, Homesites, Water-based homesites.

The objective of the research was to investigate the probability of finding enough information to warrant an intensive study of the economic effects of water quality upon residential location decisions. The investigation was localized to the Rockaway River area, where water pollution problems are known to have been serious, and considerable local interest in the matter was known to exist. It seems on the basis of this exploratory study that water quality has a relationship to value of homes in the Rockaway River area. Homeowners along clean sections of the river consider its presence an advantage; whereas along polluted sections, homeowners consider the river detrimental. However, there are so many complicating factors that the results obtained are statistically indeterminate. More intensive analysis would be required to separate out the effects of pollution from effects of flood risks, differing economic status of sample populations, extent of knowledge or ignorance of the situation and the constraint imposed by the legal imposition of a freeze upon construction, which tended to raise values of existing homes through scarcity. Guidelines for further research are suggested.
W70-04686

RATIONAL INVESTMENT BEHAVIOR IN THE FACE OF FLOODS,
California Univ., Berkeley. Center for Research in Management Science.
For primary bibliographic entry see Field 06F.
W70-04689

INFORMATIONAL NEEDS ON CHANGES IN RURAL WATERSHEDS AND THEIR RELATIONSHIPS TO PLANNING ACTIVITIES,
Texas Water Development Board, Austin; and International Boundary and Water Commission, El Paso, Texas.
For primary bibliographic entry see Field 04C.
W70-04724

RECOMMENDATIONS FOR WATERSHED RESEARCH PROGRAMS,
William C. Ackermann, Norman H. Crawford, Carl F. Izzard, Max Kohler, and Walter B. Langbein.
Office of Water Resources Research, Report of Panel on Watershed Research, June 1966. 21 p, 21 ref.

Descriptors: *Water resources research act, *Research and development, *Research facilities, Demonstration watersheds, Model studies, Hydraulic models, Mathematical models, Urbanization, Grants, Laboratories, Planning.
Identifiers: Water resources research.

An advisory report on watershed research is presented, covering the following subject areas: (a) The principal subject-matter and geographic areas of watershed research for which previous work has already provided substantially adequate knowledge; (b) watershed research subjects or techniques which past work indicates are not likely now to yield results sufficient to justify additional substantial research effort; (c) watershed research subjects that now appear promising areas for increased emphasis; and (d) recommendations as to measures under the Water Resources Research Act that might aid in bringing about needed increases of research. The panel recommendations for consideration of OWRR in administering programs under P.L. 88-379 cover watershed research on: experimental watersheds, representative watersheds, physical models, mathematical models, and effects of urbanization. Mathematical modeling of watershed behavior is a fruitful field of study. Greater emphasis on the subject of effects of urbanization is recommended. (Knapp-USGS)
W70-04760

THE DELAWARE RIVER BASIN COMMISSION, A PROTOTYPE IN RIVER BASIN DEVELOPMENT,
Delaware River Basin Commission, Washington, D.C.
Vernon D. Northrop.
Journal of Soil and Water Conservation, Vol. 22, No. 2, Reprint, March-April 1967, 4p., 2 photo, 1 ref.

Descriptors: *Interstate commissions, Water supply, Water pollution.
Identifiers: *Delaware River Basin Commission, Clean Water Restoration Act.

The water crisis of the last third of the 20th century includes a tripling of water supply needs by the year 2000, an inadequate water supply, and the need of between $40 billion to $100 billion to win the fight against water pollution. The article discusses the development of a federal-interstate compact organization as a mechanism for dealing more effectively with the water problems. The characteristics and importance of the Delaware River are presented along with a discussion of two previous compact plans. Four states, New York, Pennsylvania, New Jersey and Delaware, organized the Delaware River Basin Advisory Committee. This Committee developed a federal-interstate compact, developed the type of organizational approach for the Delaware basin, and drafted the terms of the compact and obtained support for its enactment. The resulting federal-interstate agency has proven to be an effective organization; it is responsible for the Clean Water Restoration Act. Fears of conflicts of interest have been unfounded. (Grossman-Rutgers)
W70-04824

THE DISCOUNT RATE IN PUBLIC INVESTMENT EVALUATION - VIEWS FROM THE FEDERAL GOVERNMENT: A PANEL DISCUSSION,
Soil Conservation Service, Washington, D.C.
Charles F. Lemon.
Conf. Proc., Comm. on the Econ. of Water Resources Develop., Denver, Colo., p. 91-97, Dec. 17-18, 1968. 7p., 1 tab.

Descriptors: *Discount rate, *Small watersheds, Federal government, Interstate.
Identifiers: Water Resources Council.

The implications of various discount rates on water resource projects under the small watershed program, as administered by the Soil Conservation Service, are described. First a historical background of the small watershed program is presented. Then the discount rate as proposed by the Water Resources Council is presented. This discount rate is based on the interest rate on the average yield during the preceding fiscal year on the interest-bearing marketable securities of the United States. This formula leads to a higher rate. Its effect is demonstrated by an analysis of the watershed project in the Ozark region of Arkansas. A table is presented which indicates the effect of using the higher interest rate of 4 5/8 percent for benefit-cost evaluation. (Grossman-Rutgers)
W70-04825

THE DISCOUNT RATE IN PUBLIC INVESTMENT EVALUATION - VIEWS FROM THE FEDERAL GOVERNMENT: A PANEL DISCUSSION,
Water Resources Council, Washington, D.C.
Harry A. Steele.
Conf. Proc., Comm. on the Econ. of Water Resources Develop., Denver, Colo., 83-85, Dec. 17-18, 1968. 3p, 1 graph.

Descriptors: *Discount rate, Interest rate, Water Resources Planning Act, Economic efficiency, Federal government.
Identifiers: Coupon rate, Government bonds, Water Resources Council.

The difference between discount rates based on the opportunity costs in private market and that based on social time preference is so great that the method chosen will drastically change the formulation of water resources plans. Therefore, the choice of the discount rate will affect many policy objectives and economic efficiency. Under the Senate Document 97 the yield rate on long-term government bonds (i.e., coupon rate) was used as the discount rate. In July of 1968, the Water Resources Council proposed a formula which would start at 4 5/8 percent and change with the average yield on long-term bonds of the preceding year but not more than one percentage point in any one year. A later proposal would be a discount rate starting at 4 5/8 percent and would use a 5-year moving average, but limiting yearly changes to 1/4 of a percentage point. A task force and natural and regional hearings are intended to improve procedures in determining the discount rate and planning policies. A graph illustrating the second discount rate proposal overtime is given. (Grossman-Rutgers)
W70-04826

THE DISCOUNT RATE IN PUBLIC INVESTMENT EVALUATION-VIEWS FROM THE FEDERAL GOVERNMENT: A PANEL DISCUSSION,
Office of the Chief of Engineers (Army), Washington, D.C. Civil Works Directorate.
B. J. Tofani.
Conf. Proc., Comm. on the Econ. of Water Resources Develop., Denver, Colo., pp. 99-101, Dec. 17-18, 1968. 3 p.

Descriptors: *Discount rate, *Resource development, Federal Government.
Identifiers: Water Resources Council, Corps of Engineers.

The effect of a higher discount rate is found within the scope of individual projects. Under the higher rate the increments of projects will be found unjustified, therefore projects will end up smaller. Also, other projects will be restricted due to the higher rate. The magnitude of construction under the Corps of Engineers' program is not directly affected by the discount rate for the primary constraint of the program is the funding level. Under the higher discount rate in project evaluation, lesser weight is given to future benefits in comparison to near-term benefits. A brief history of the role of the Federal Government in water resources is presented. Its role in water resources development is found to be a complicated one. (Grossman-Rutgers)
W70-04827

THE DISCOUNT RATE IN PUBLIC INVESTMENT EVALUATION - VIEWS FROM THE FEDERAL GOVERNMENT: A PANEL DISCUSSION,
Committee on Appropriations (U.S. Senate).
Kenneth J. Bousquet.
Conf. Proc., Comm. on the Econ. of Water Resources Develop., Denver, Colo., pp 103-106, Dec. 17-18, 1968. 4p.

Descriptors: *Discount rate, Resources development, Cost-benefit analysis.
Identifiers: *Senate Subcommittee on Economy in Government, Water Resources Council.

The increase in the discount rate from 3 1/4 percent as set forth in Senate Document 97 to 4 5/8 percent as proposed by the Water Resources Council is a 42 percent increase. It is suggested that a stepped increase occur to allow time for the development of better techniques of project benefits. In the field of water resources development benefit-to-cost analyses are made to determine if the objective of the project is to be met. An example of the type of analysis that follows from recommendations of the Senate Subcommittee on Economy in Government as applied to a business is presented. The example cited shows that a higher discount rate decreases the apparent desirability of

projects where the benefits increase over the life of the project than those where the early returns are high. A high proportion of early returns usually means a less than optimum size project. (Grossman-Rutgers)
W70-04828

THE VALUE OF RESERVOIR RECREATION,
Cornell Univ., Ithaca, N.Y. Dept. of Agricultural Economics.
Jeff Romm.
Cornell University Water Resources and Marine Sciences Center, Technical Report No. 19, Aug. 1969, 102p, 19 fig, 24 tab, 15 ref.

Descriptors: *Recreation, *Reservoirs, *Public benefits, Cost-benefit analysis, Recreation demand, Estimating.
Identifiers: *Whitney Point Reservoir, *Recreation benefit estimating.

This study compares several techniques of estimating and benefits of reservoir recreation. A survey was taken at Whitney Point Reservoir, Broome County, New York; the results were used as sources of data for this study. The survey methodology is discussed, and the purposes of recreation benefit estimating and demand estimation techniques are examined. Then the following techniques are explained and examined: The Clawson Approach, Consumer Surplus Approach, Willingness to Pay, Government Payment, Consumers Preference Approach, Social Preference, and Requirements Approach. The results for the different estimation techniques are summarized. Finally, public needs and administrative goals are examined and a conclusion is included. (Grossman-Rutgers)
W70-04829

ALTERNATIVE INSTITUTIONAL ARRANGEMENTS FOR MANAGING RIVER BASIN OPERATIONS.
Water Resources Council, Washington, D.C.

Washington, D.C.: Water Resources Council, August 1967, 8 p.

Descriptors: *Management, *Administration, *Planning, *Institutions, *River basins, Institutional constraints, Interstate compacts, Interstate commissions, River basin commissions.
Identifiers: *River basin management.

The report reviews eight types of management arrangements: (1) the interstate compact; (2) the federal interstate compact; (3) river basin commissions; (4) basin inter-agency committees; (5) regional federal-state commissions; (6) intra-state special districts; (7) the federal regional agency; and (8) the single federal administration. Each was analyzed to determine its effectiveness, capabilities and limitations in performing the following principal functions: (1) regulation; (2) construction; (3) financial capability; (4) operation; (5) comprehensive river basin planning; (6) evolution and amendment; and (7) ability to obtain cooperation. It is concluded that the following three types can be useful instruments in appropriate circumstances and under appropriate terms and conditions in the management of river basin resources: interstate compacts, federal-interstate compacts, and separate federal and state institutions assisted by joint federal-state planning bodies. The report recognizes that no one institution can be said to be the best for all situations and recommends that normally, before a new institutional arrangement is established in any basin, the needs of the basin should be determined and the major outlines of a basic comprehensive plan for the conservation, development, and management of the basin should be clearly seen. (Davis-Chicago)
W70-04834

CHAPTER III: REGIONAL ECONOMIC ANALYSIS AND RIVER BASIN PLANNING,
Battelle Memorial Inst., Columbus, Ohio; Indiana Univ., Bloomington; Massachusetts Inst. of Tech., Cambridge; and Chicago Univ., Ill.
For primary bibliographic entry see Field 06A.
W70-04838

CHAPTER IV: CONTEMPORARY REGIONAL PROJECTION MODELS,
Battelle Memorial Inst., Columbus, Ohio; Indiana Univ., Bloomington; Massachusetts Inst. of Tech., Cambridge; and Chicago Univ., Ill.
For primary bibliographic entry see Field 06A.
W70-04839

CHAPTER V: PHILOSOPHY AND METHODOLOGY OF APPROACH,
Battelle Memorial Inst., Columbus, Ohio; Indiana Univ., Bloomington; Massachusetts Inst. of Tech., Cambridge; and Chicago Univ., Ill.
For primary bibliographic entry see Field 06A.
W70-04840

CHAPTER VI: THE REGIONAL SETTING OF THE STUDY,
Battelle Memorial Inst., Columbus, Ohio; Indiana Univ., Bloomington; Massachusetts Inst. of Tech., Cambridge; and Chicago Univ., Ill.
For primary bibliographic entry see Field 06A.
W70-04841

CHAPTER VII: AN OVERVIEW OF THE MODEL,
Battelle Memorial Inst., Columbus, Ohio; Indiana Univ., Bloomington; Massachusetts Inst. of Tech., Cambridge; and Chicago Univ., Ill.
For primary bibliographic entry see Field 06A.
W70-04842

CHAPTER XI: THE WATER SECTOR,
Battelle Memorial Inst., Columbus, Ohio; Indiana Univ., Bloomington; Massachusetts Inst. of Tech., Cambridge; and Chicago Univ., Ill.
For primary bibliographic entry see Field 06A.
W70-04843

MAN AND HIS URBAN ENVIRONMENT,
North Carolina Univ., Chapel Hill. School of Public Health.
Daniel A. Okun, and Stanley J. Weidenkopf.
Dept of Environmental Sciences and Engineering Publication No. 207. Presented at the Regional Conference on Improving the Physical Environment of the South, Co-sponsored by the Southern Conference of the Council on State Governments and the Agricultural Policy Institute, Atlanta, Georgia, 16-17 December, 1968, 21p, 28 ref.

Descriptors: *Environment, Social aspects, Environmental effects, Political aspects, Planning, Standards.
Identifiers: *Urban environment, *Resource reutilization, *Comprehensive environmental planning.

Focusing on the existing degradation of the environment, this paper stresses that man not only contaminates his environment, but is to a large degree the designer of his environment. After a short historical survey, the need for the reutilization of resources is stated. Several elements of the urban environment are discussed in detail including: the urban population problem, the physical environment, the social environment, and the development of environmental standards. A number of requirements for solving the problems of the urban environment are described. The first and most important requirement is an enlightened and aroused public which clearly recognizes the problem. A second requirement is a responsive political structure. A third requirement is an adequately organized and supported scientific community to determine the effect of environment on man, and man's ability to adopt to environmental changes, to establish acceptable limits, to develop effective and economical control procedures; and to educate and train future scientists for research, teaching and practice. Fourth, comprehensive environmental planning must be utilized. Finally, the implementation of planning and control programs through participation of industry, the professions, voluntary citizen's organizations and local government is essential in the formation of effective programs of environmental control. (Davis-Chicago)
W70-04846

ENVIRONMENTAL PLANNING WITH SPECIAL RELATIONS TO NATURAL RESOURCES,
North Carolina Univ., Chapel Hill. School of Public Health.
Maynard M. Hufschmidt.
University of North Carolina, School of Public Health, Department of Environmental Sciences and Engineering, Publication No 192, July, 1966, 33 p, 34 ref.

Descriptors: *Planning, *Management, *Environment, *Natural resources, *Methodology, Decision making, Public health, Aesthetics, National income, Economics.
Identifiers: *Comprehensive environmental planning, *Public investment decision model.

The concept of comprehensive environmental planning included as managing the air space, the water-resource and the land-space, in terms both of handling pollution and wastes, and of urban design. Three fundamental issues are raised. First, what are the underlying goals or objectives of comprehensive environmental planning. Second, who are the environmental planners, or who should they be. Third, what planning theories, processes and techniques are appropriate. Three goals or objectives were identified: (1) physical and mental health, (2) aesthetics, and (3) national income (or regional or class income). Three groups have assumed the role of environmental planners in the past; environmental scientists, environmental designers and social scientists. However, the task must be shared by all in the application of social science theory and technique to environmental problems, through combined research by the three groups mentioned above. The final issue is addressed by the suggestion that the public investment decision model be adopted, and that the problems of environmental planning be examined in terms of this model. The application of this model is discussed considering various approaches: standards, multiple standards-classification, safe minimum standard, system optimization, economic efficiency, and multiple objectives. Several methodological problems are discussed as well: (1) definition of the production function; (2) the cost-input function; (3) derivation of the benefit-output function; and (4) the objective function. (Davis-Chicago)
W70-04847

MANAGING THE GREAT LAKES WATER RESOURCE,
North Carolina Univ., Chapel Hill. School of Public Health.
Daniel A. Okun.
Dept. of Environmental Sciences and Engineering, Publication No 195. For presentation at the Annual Conference of the Water Pollution Control Federation, Chicago, Illinois, September 24, 1968, 8 p, 6 ref.

Descriptors: *Management, *Water resources, *Great Lakes, Lakes, Water pollution, Water quality, Water pollution control, Diversion, Water reuse.
Identifiers: *Hierarchy of water quality, Chicago (Ill).

The Great Lakes constitute the largest fresh water resource in the world. Because there are no large

rivers that drain into the Great Lakes Basin, and because the intensity of development is expected to accelerate due to urban growth, the urgency for sound management of this water resource is clear. Changes in water quality in the Great Lakes have tended to deteriorate, especially in the lower lakes. A steady increase in the concentration of chemicals indicative of increased man-made pollution has been identified. Two proposals for improving the quality of water in the Great Lakes can be explored. First, large scale improvement of water quality can be obtained through the diversion of effluents to other water bodies. The classic example is the City of Chicago whose wastewater is diverted into the Mississippi River system. Second, a hierarchy of water quality could be adopted. Much of the water needs in the Great Lakes Basin could be served by reclaimed wastewaters. In addition, the reclaiming process would serve to improve the quality of the initial effluents. (Davis-Chicago)
W70-04848

BACKGROUND MATERIAL COVERING THE FEASIBILITY OF CREATING ISLANDS IN LAKE MICHIGAN NEAR CHICAGO,
Raleigh Spinks.
Chicago City Planning Department, January 1961. 63 p, 7 fig, 39 ref.

Descriptors: *Lake Michigan, *City planning, *Islands, Urbanization, Planning, Attitudes, Social aspects.
Identifiers: *Chicago, *Policy making.

This paper attempts to provide background material relating to the creation of offshore islands in Lake Michigan near Chicago. Four main areas are covered: (1) Local planning considerations, where the concept of whether islands are a good idea in light of the Chicago Comprehensive Plan and where conflicting existing and proposed developments, conflicting public and private interests, and local approvals required are examined; (2) government policies and regulations are examined at different levels that govern the use of lake land; (3) engineering aspects of design and cost are analyzed; and (4) existing and proposed island projects in the Chicago region are described. It is the major conclusion of this paper that there appears to be no governmental, engineering or financial facts that would hold back the realistic development of islands in the lake. It appears that under the right circumstances, the free market would allow the islands to be built on a competitive basis. The major drawback appears to be the gap between what is technically feasible from an engineering and financial viewpoint and what is acceptable by the public, or understood by the public. In conclusion, preliminary research indicates that the question of islands in the lake is a city planning 'policy and values' problem rather than an engineering or financial problem. (Davis-Chicago)
W70-04899

THE WATER SITUATION,
Arizona State Water Engineer; and Arizona Interstate Stream Commission.
For primary bibliographic entry see Field 03B.
W70-04914

ESTHETIC INTERESTS IN WATER YIELD IMPROVEMENT,
Arizona Conservation Council.
For primary bibliographic entry see Field 03B.
W70-04917

NATIONAL POLICY PROBLEMS IN WATER RESOURCES.
American Society of Civil Engineers. Washington, D.C. National Capitol Section.

Available from Dean C. Pappas, Secretary, National Capitol Section, ASCE, c/o Board of Engineers for Rivers and Harbors, Second and Q Sts, S.W., Washington, D.C. Proceedings of Spring 1968 Water Resources Conference, Catholic University, Washington, D.C., May 11, 1968. American Society of Civil Engineers, National Capitol Section, Washington, D.C., 1969. 42 p.

Descriptors: *Evaluation, *Water policy, *Cost sharing, *Social needs, *Water resources planning act, Benefits, Federal project policy, Formulation, Future planning, Institutions, Water resources development, Cost repayment, Social values, Cost-benefit analysis, Economic efficiency.
Identifiers: *Planning objectives, Economic development, Regional development, Environmental quality.

The theme of the conference was on national policy problems. The interdisciplinary approach to these problems was emphasized by the physical, economic, financial, ecologic, sociologic, and political interrelationships discussed. Major topics dealt with water resources development in the context of total social needs, cost sharing and repayment, the viability of current institution, evaluation of outputs, future planning, and changes needed in national water policies. Principal speakers were Senator Frank E. Moss, Theodore M. Schad, Burnham H. Dodge, James J. Flannery, Philip M. Glick, Charles Howe, Lyle E. Craine, and John D. Whisman. The Conference was sponsored by the Water Resources Committee, National Capitol Section, ASCE, at the Catholic University, Washington, D.C. on May 11, 1968. (Blanchard-ASCE)
W70-04978

EVALUATION OF RESOURCE USE AND ECONOMIC EFFECTS DUE TO IRRIGATION WATER AVAILABILITY IN TEXAS,
Texas A and M Univ., College Station. Water Resources Inst.
Warren L. Trock.
Available from the Clearinghouse as PB-190 361, $3.00 in paper copy, $0.65 in microfiche. Technical Report No 22, Water Resources Institute, Texas A and M University, August 1969. 76 p, 27 tab, 3 fig, 48 ref. OWRR Project B-005-TEX.

Descriptors: *Irrigation, *Economic impact, *Evaluation, Water development, Water supply, Resource economics, Optimum resource use, Linear programming.

Estimation of the effects on agriculture of alternative levels of water development in Texas was accomplished in this study. Use of land and water resources in crop production with variable total supplies of irrigation water was projected to 1980, 2000, and 2020. Constraints on output were established as Texas' shares of U.S. food and fiber requirements. Constraints on water supplies were developed by state water planners. It was concluded that without further water development, irrigated acreage in Texas would decline over time and Texas' shares of some U.S. good requirements would diminish.
W70-04983

THE EVALUATION OF RISK IN MARINE CAPITAL INVESTMENTS,
Robert F. Klausner.
Engineering Economist, Vol 14, No 4, p 183-214, July-August 1969. 32 p, 4 fig, 3 tab, 11 ref.

Descriptors: *Risks, *Mathematical models, *Simulation analysis, *Capital, *Investment, Return (Monetary), Decision making, Probability, Economic justification.
Identifiers: Cash flow.

Mathematical models for solving problems of uncertainty and risk in the evaluation of capital investment opportunities were discussed. Traditionally used techniques were found to be deficient because they did not provide an overall indicator of outcome variability or a consistent framework for analysis. They therefore resulted in a qualitative 'feel' rather than a quantitative assessment of risk. The Probabilistic Cash Flow Simulation technique was recommended over the simple Discounted Cash Flow analysis technique. In addition to indicating the discounted cash flow return, the method also showed the probability associated with realizing the investor's minimum acceptable return. The Probabilistic Cash Flow Simulation technique thus provided the decision-maker with the risk return information necessary for him to establish an investment's economic desirability. It was suggested that the technique would prove valuable in the evaluation of future marine capital investments. (Thiuri-Cornell)
W70-04990

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

THE DISCOUNT RATE IN PUBLIC INVESTMENT EVALUATION; PART I. VIEWS FROM THE ACADEMY.
Western Agricultural Economics Research Council, Denver, Colo. Committee on the Economics of Water Resources Development.

Water Resources and Economic Development of the West, Report 17: Discount Rate in Public Investment Evaluation, Part I: Views from the Academy. p 1-82, 1968. 21 tab, 1 fig, append.

Descriptors: *Water resources development, *Discount rate, *Decision making, *Project planning, *Investment, Arid lands, Federal government, Water policy, Interest rate, Budgeting, Economic justification, Economics, Planning, Programs, Social aspects, Social values, Cost-benefit analysis, Cost-benefit ratio, Social impact.
Identifiers: *Western U. S., *Opportunity cost, Sensitivity analysis, Planning, Programming and Budgeting System (PPBS).

The decision of where and when to invest public funds is frequently influenced by choice of which discount rate to apply to economic analysis of the proposed program. This is of particular relevance to public investment in water resource development programs for the arid western U.S., where benefit-cost analysis has been employed for many years. With increasing utilization in recent years of the Planning, Programming and Budgeting System (PPBS) for public decision making, the discount rate has assumed increasing importance in allocation of public investment funds. Four academic exponents present diverse opinions on subjects such as measurement of the social opportunity cost of public funds; changes in discount rate over a period of time; measurement of the opportunity cost of private investment and proposal of this measurement as proper for determining public discount rate; relationship between the opportunity cost of displaced private spending and the social discount rate; and the proposal that projects be evaluated with alternative discount rates and results of a sensitivity analysis. (Crouse-Ariz)
W70-04903

THE DISCOUNT RATE IN PUBLIC INVESTMENT EVALUATION, PART II; VIEWS FROM THE FEDERAL GOVERNMENT: A PANEL DISCUSSION,
Western Agricultural Economics Research Council, Denver, Colo. Committee on the Economics of Water Resources Development.
Harry A. Steele, Jim T. Casey, Charles F. Lemon, B. J. Tofani, and Kenneth J. Bousquet.
Water Resources and Economic Development of the West, Report 17: Discount Rate in Public Investment Evaluation, Part II: Views from the Federal Government: A Panel Discussion. p 83-106, 1968. 1 tab, 1 fig.

Descriptors: *Water resources development, *Discount rate, *Decision making, *Project planning, *Investment, Economic impact, Arid lands, Federal government, Soil conservation, Land reclamation, Multi-purpose projects, Water

policy, Interest rate, Budgeting, Economic justification, Economics, Planning, Programs, Social values, Cost-benefit analysis, Cost-benefit ratio.
Identifiers: *Western U. S., *Opportunity cost.

A panel of government officials representing major water resource development agencies such as Bureau of Reclamation, Soil Conservation Service, Department of the Army Corps of Engineers and U.S. Senate Committee on Appropriations discuss application of discount rate in project planning and their agency's views and experience. It is apparent that the difference between rates established by opportunity cost of private investment and those of social time preference is so great that the choice of either would drastically change formulation of water resource plans. This would have particular impact in the semiarid and arid Western U.S. where major water resource developments have long been evaluated on the basis of the coupon rate on long term government bonds. However, government financing policy has tended to keep the coupon rate very low in relation to the real average yield rate on all government securities. Attempts to establish guidelines for arriving at realistic and socially acceptable discount rates present a real challenge to planners and economists and will have great effect on water resource development programs. (Crouse-Ariz)
W70-04904

THE REGIONAL INTEREST IN WATERSHED MANAGEMENT,
Western States Water Council.
For primary bibliographic entry see Field 04C.
W70-04913

6D. Water Demand

FORECASTING MUNICIPAL WATER REQUIREMENTS, VOLUME I - THE MAIN II SYSTEM, VOLUME II - THE MAIN II SYSTEM USER'S MANUAL.
Hittman Associates, Inc., Columbia, Md.

Available from the Clearinghouse as PB-190 275 (Vol I), PB-190 276 (Vol II), $3.00 each in paper copy, $0.65 each in microfiche. Hittman Associates Inc., HIT-413, September 1969. Vol. I, 208 p.; Vol. II, 425 p. OWRR Project C-1396.

Descriptors: *Water requirements, *Forecasting, *Municipal water, Water demand, Computer models, Statistical models, Computer programs, Regression analysis, Water management (Applied), Water utilization, Water demand, Evaluation, Cities.
Identifiers: Metropolitan water requirement model, Baltimore (Md), Baton Rouge (La), Columbia (Md).

A previously developed computer model of municipal water requirements, the MAIN I System, was used as a basis for a study of forecasting methods. The economic and demographic parameters of municipal water use were determined and their growth patterns analyzed. Data from 50 metropolitan areas were used to develop statistical models of the growth of these parameters. The models and other projection techniques were combined into a comprehensive forecasting method, named the MAIN II System. A computer program was prepared which incorporates the water requirements model as well as the forecasting system. Information required to prepare a water requirements forecast for an urban area is confined to readily available economic, demographic, and land--use data, and forecasts include detailed estimates for up to 200 water user categories. The MAIN II System was used to prepare forecasts for Baltimore, Md., Baton Rouge, La., and Columbia, Md. These case studies are presented and analyzed. Volume I describes the supporting research and the case studies. Volume II is a User's Manual, presenting a complete listing and flow chart of the computer program and giving detailed instructions for data preparation and use of the program. (See also W70-04691, W70-04692, W69-03201 and W69-03202). (Boland-Hittman)
W70-04690

MAIN C: COMPUTERIZED METHODOLOGY FOR EVALUATION OF MUNICIPAL WATER CONSERVATION RESEARCH PROGRAMS, VOLUME I -- DEVELOPMENT OF THE MAIN C SYSTEM, VOLUME II -- USER'S MANUAL AND SYSTEM DOCUMENTATION.
Hittman Associates, Inc., Columbia, Md.

Available from the Clearinghouse as PB-190 277 (Vol. I), and PB-190 278 (Vol. II), $3.00 each in paper copy, $0.65 each in microfiche. Hittman Associates Inc., HIT-409, August 1969. Vol I, 116 p.; Vol II, 313 p. OWRR Project C-1397.

Descriptors: *Water conservation, *Municipal water, Water requirements, *Economic impact, Computer models, Computer program, *Evaluation, Water utilization, Water management (Applied), Cities.

Existing literature and limited field studies were used to estimate, for each of 137 user categories, water use by purpose (kitchen, laundry, sanitary, cooling and condensing, etc.). These estimates were used to develop a computer model of municipal water use. Proposed water conservation devices, processes, or practices can be described in terms of their influence on water use for each purpose within each user category, and the computer model used to estimate the impact on the water demands of the entire community. A method for analyzing the economic impact of the water conservation measure is included in the model. Implementation costs, reductions in water utility operating costs, deferment of capital investments, and changes in revenue are included in the economic analysis. Volume I describes the supporting research and the design of the computer model. Volume II is a User's Manual, presenting a complete listing and flow chart of the computer program and giving detailed instructions for data preparation and the use of the program. (See also W70-04690, W70-04692, W69-03201 and W69-03202). (Boland-Hittman)
W70-04691

MAIN I: A SYSTEM OF COMPUTERIZED MODELS FOR CALCULATING AND EVALUATING MUNICIPAL WATER REQUIREMENTS -- ADDENDUM TO FINAL REPORT.
Hittman Associates, Inc., Columbia, Md.

Available from the Clearinghouse as PB-190 272, $3.00 in paper copy, $0.65 in microfiche. Hittman Associates, Inc., Addendum to HIT-336 (W69-03201, W69-03202; PB-182 555, PB-182 556), October 1969. 58 p. OWRR Project C-1397.

Descriptors: *Water requirements, *Municipal water, Water demand, Computer programs, Computer model, Water management (Applied), Water utilization, Evaluation, Cities.
Identifiers: Metropolitan water requirement model, Baton Rouge (La), Anne Arundel County (Md), Baltimore (Md), Park Forest (Ill).

A computer model of municipal water requirements was developed under a previous program and named the MAIN I System. Experience with the application of this model in estimating current water requirements for Baton Rouge, La., Anne Arundel County, Md., Baltimore, Md., and Park Forest, Ill., led to modifications and improvements. This addendum reports these applications and documents the changes in the estimating method which resulted. Comments received on the original report are also reviewed and additional information presented on the basis of the computer model. Where actual water demand data were available, various estimates of demand for the cities studied were from 12.6 percent below to 2.5 percent above actual demands. Estimates for specific user categories and for specific months and seasons were also in close agreement (See also W70-04690 and W70-04691) (Boland-Hittman)
W70-04692

PETROLEUM INDUSTRY IN ILLINOIS, 1968: PART 2. WATERFLOOD OPERATIONS,
Illinois State Geological Survey, Urbana.
T. F. Lawry.
Illinois State Geological Survey Illinois Petroleum 92, p 67-122, 1969. 56 p, 5 tab

Descriptors: *Oil fields, *Illinois, *Flooding, *Injection wells, *Secondary recovery (Oil), Injection, Oil reservoirs, Brines, Saline water, Water utilization, Water demand.
Identifiers: Oil field waterflooding.

Forty-four new waterfloods were added in Illinois oil fields in 1968 while 50 waterfloods were abandoned and 12 waterflood listings were dropped for lack of data or because they were combined with other waterfloods. The area subject to fluid injection was increased by 11,500 acres in the new waterflood projects, and by 3600 acres in the expansion of older waterflood projects. Acreage subject to fluid injection is now approximately 47.7 of the total pay acreage in the state. (Knapp-USGS)
W70-04737

QUANTITATIVE ANALYSIS OF RESIDENTIAL WATER-USE PATTERNS IN MAYAGUEZ, PUERTO RICO,
Puerto Rico Univ., Mayaguez. Water Resources Research Inst.
Ausberto Guilbe.
PB-190 439. Water Resources Research Institute, School of Engineering, Mayaguez, Puerto Rico, June, 1969. 96p, 44 tabs, 20 fig, 3 append, 10 ref.

Descriptors: *Water utilization, *Correlation analysis, Computer models, Statistical models, Social aspects.
Identifiers: Mayaguez, Puerto Rico.

A practical functional relationship model to correlate residential water use with socio-economic factors which are known to influence the water usage is developed. The data was obtained from sample surveys. The collected data was subject to analyses in order to disclose the form of the relationship between water use and influencing factors. It was found that the influencing factor or independent variable is property value. Water use is the dependent variable. The property value was used as an indirect practical indicator of other factors. With regard to public dwellings it was found that the number of bedrooms, rather than property value, served as a significant independent variable. The computer program used in analyzing the data is included. (Grossman-Rutgers)
W70-04830

CHAPTER VI: THE REGIONAL SETTING OF THE STUDY,
Battelle Memorial Inst., Columbus, Ohio; Indiana Univ., Bloomington; Massachusetts Inst. of Tech., Cambridge; and Chicago Univ., Ill.
For primary bibliographic entry see Field 06A.
W70-04841

CHAPTER XI: THE WATER SECTOR,
Battelle Memorial Inst., Columbus, Ohio; Indiana Univ., Bloomington; Massachusetts Inst. of Tech., Cambridge; and Chicago Univ., Ill.
For primary bibliographic entry see Field 06A.
W70-04843

PRESENT AND PROPOSED LEGAL CONTROL OF WATER RESOURCES IN WISCONSIN,
For primary bibliographic entry see Field 06E.
W70-04877

DIGITAL SIMULATION TECHNIQUES IN POWER SYSTEM PLANNING,
Norwegian Water Resources and Electricity Board, Oslo.
For primary bibliographic entry see Field 06A.
W70-04991

6E. Water Law and Institutions

ALTERNATIVE INSTITUTIONAL ARRANGEMENTS FOR MANAGING RIVER BASIN OPERATIONS.
Water Resources Council, Washington, D.C.
For primary bibliographic entry see Field 06B.
W70-04834

MAN AND HIS URBAN ENVIRONMENT,
North Carolina Univ., Chapel Hill. School of Public Health.
For primary bibliographic entry see Field 06B.
W70-04846

INDIANA WATER LAW AND SUGGESTIONS FOR ACTION,
G. Graham Waite.
Indiana Water Res Study Committee, 1968. 262 p, 746 ref, append.

Descriptors: *Indiana, *Water law, *Legislation, *Water rights, State governments, Local governments, Planning, Administrative agencies, Judicial decisions, Riparian rights, Public rights, Navigable waters, Non-navigable waters, Prescriptive rights, History, Lakes, Ponds, Streams, Legal aspects, Watercourses (Legal), Surface waters, Groundwater, Geographical regions, Spring waters, Artificial precipitation, Publications, Surveys.
Identifiers: *Legislative reports, *Studies.

The Indiana Water Resources Study Committee instituted this study and report on the existing law of water rights in Indiana. Chapter one examines private rights in water and deals in subdivisions with: (1) the physical setting and uses of Indiana's water; (2) riparian rights in surface watercourses; (3) the appropriation doctrine; (4) differences with respect to navigable and non-navigable watercourses; (5) differences with respect to streams, lakes, and ponds; (6) rights to diffused surface water; (7) rights to groundwater; (8) rights to use spring water and artificially developed waters; (9) the effect of rainmaking on water rights; (10) prescriptive rights; (11) transfer of water rights; and (12) remedies to protect water rights. Chapter two examines public rights in water and deals in subdivisions with: (1) general public rights; (2) early and recent judicial developments; and (3) statutory developments. Chapter three examines the impact on Indiana water law of administrative agencies and local units of government and, within the framework of two major subdivisions, deals at length with Indiana water administrative agencies, and with the role of local government in the shaping of Indiana water rights. (See also W70-04858 thru W70-04869). (Marsee-Florida)
W70-04857

INDIANA WATER LAW AND SUGGESTIONS FOR ACTION,
G. Graham Waite.
Indiana Water Res Study Committee, p 1-5, 1968.

Descriptors: *Indiana, *Hydrogeology, *Riparian land, *Watercourses (Legal), Riparian rights, Groundwater, Glaciers, Geomorphology, Lakes, Lake forming, Rivers, Streams, Terrain analysis, Topography, Irrigation effects, Irrigation, Water sources, Use rates, Water utilization, Recreation demand, Legal aspects, Judicial decisions, State governments, Regions, Slopes, Great Lakes Region.

Most of Indiana is from 500 to 1,000 feet above sea level. Generally hillier in the south than in the north, the land tilts slightly to the southwest, so that most of Indiana's streams and rivers flow southwest and ultimately into the Mississippi. The geology is varied and includes many remnants of glacial lakes. Thick glacial deposits are the state's most important source of groundwater. Both ground and surface water are readily available and usually plentiful; however, it is estimated that by 1975 an increasing population, irrigation needs during dry seasons, recreational demands, and other potential needs will double the volume of water used in 1954. In Indiana private water rights are governed by modifications of the riparian rights doctrine although there are few cases dealing with riparian rights in Indiana. 'Riparian land' has not been defined in this state although a statute not yet interpreted could be a basis for such definition. One Indiana court has attempted to broadly define 'watercourse' in terms of substantial existence and unity, and regularity and dependability of flow along a definite course. (See W70-04857). (Marsee-Florida)
W70-04858

INDIANA WATER LAW AND SUGGESTIONS FOR ACTION,
G. Graham Waite.
Indiana Water Res Study Committee, p 5-11, 1968.

Descriptors: *Indiana, *Riparian rights, *Natural flow doctrine, *Reasonable use, Alteration of flow, Artificial use, Domestic water, Legal aspects, Legislation, Judicial decisions, Obstruction to flow, Relative rights, Riparian waters, Usufructuary right, Waste disposal, Irrigation, Impoundments, Consumptive use, Agriculture, State governments, Social values, Social impact.

The riparian rights doctrine, as first set forth, gave the riparian owner a right to the undiminished, unaltered, natural flow of a watercourse. Were this natural flow doctrine strictly applied, it would prohibit all consumptive uses of water. Indiana has developed the more pragmatic doctrine of 'reasonable use.' This doctrine allows reasonable interference with natural flow. Whether a particular use is reasonable is a question of fact and will depend upon the circumstances in the particular case. Some jurisdictions distinguish between domestic and artificial uses, allowing the riparian owner to satisfy his domestic needs even to the detriment of downstream riparians. Indiana case law has not recognized this distinction, but a recent statute has. Indiana courts have occasionally shown a reluctance to test the reasonableness of a commercial use by the social value of such use. Where a lower riparian owner causes water to back up onto the land of an upper riparian owner the courts have strictly held the lower riparian owner liable for all damages. (See W70-04857). (Marsee-Florida)
W70-04859

INDIANA WATER LAW AND SUGGESTIONS FOR ACTION,
G. Graham Waite.
Indiana Water Res Study Committee, p 11-17, 1968.

Descriptors: *Indiana, *Prior appropriation, *Navigable waters, *Non-navigable waters, Riparian rights, Navigation, Rivers, Running waters, Streams, Ownership of beds, River beds, Public rights, Legal aspects, Federal government, Federal jurisdiction, Lakes, Watercourses (Legal), Priorities, Water rights, Preferences (Water rights), Judicial decisions, Legislation, State governments.

The report provides a survey description of the western appropriation doctrine and mentions similarities between that doctrine and Indiana's riparian rights doctrine. Indiana differentiates between navigable and non-navigable watercourses. Whether water is navigable or non-navigable is relevant in deciding questions of bed ownership, public rights of use, and federal regulation in particular bodies of water. Since 'navigable' does not have the same meaning in all these contexts, it becomes important to define the context in which the term is being used. Navigability is important in two situations concerning private rights. First, in deciding ownership of beds in Indiana it is necessary to know whether the body of water was navigable at the time statehood was attained. Second, if a particular body is navigable, riparian rights are subordinate to a public right of navigation. (See W70-04857). (Marsee-Florida)
W70-04860

INDIANA WATER LAW AND SUGGESTIONS FOR ACTION,
G. Graham Waite.
Indiana Water Res Study Committee, p 17-22, 1968.

Descriptors: *Indiana, *Navigable waters, *Non-navigable waters, *Ownership of beds, Navigation, Federal government, Legal aspects, State governments, Judicial decisions, Streambeds, Rivers, Lakes, Streams, Federal jurisdiction, Riparian rights, Public rights.
Identifiers: *Navigability tests.

To decide who owns the bed of a lake, river, or stream in Indiana, it is necessary to know whether that body of water was navigable at the time the area became part of a state. The general rule provides that bed title passed to the state at that time if the water was navigable, but remained in the public if the water was non-navigable. Questions of bed ownership, such as the demarcation of the bed from the upland, and of navigability are federal questions. The federal test of navigability is one of fact, turning upon whether the waters are susceptible of being used in their ordinary and natural condition as highways for commerce. These commercial tests are capable of change with time and demand. For instance, recreation is a significant commercial use today but was not at the time of Indiana's admission to the Union. The most recent Indiana Supreme Court case on the relation of navigability to bed ownership adopted the federal rule on navigability, but this did not substantially change Indiana law. The Indiana common-law test was virtually the same as the federal test. (See W70-04857). (Marsee-Florida)
W70-04861

INDIANA WATER LAW AND SUGGESTIONS FOR ACTION,
G. Graham Waite.
Indiana Water Res Committee, p 22-25, 1968.

Descriptors: *Indiana, *Riparian rights, *Ownership of beds, *Public rights, Navigable waters, Non-navigable waters, Streams, Ponds, Lakes, Rivers, Land tenure, Federal government, State governments, Judicial decisions, Legislation, Legal aspects, Relative rights, Piers, Wetlands, Streambeds, Federal jurisdiction, Water rights, Riparian land.

When a body of water is navigable according to the federal test, the state wherein the water is situated has title to the bed. If the water is non-navigable, bed title is in the owner or owners of the adjoining land. There is a presumption that a grant of land adjoining non-navigable water carries title to the bed. It is well established in Indiana that the owner of a bed beneath such non-navigable waters may control the waters above the bed as if it were his land. Where waters are navigable, a riparian owner's rights are subject to a public right of navigation. The riparian owner may not unreasonably interfere with the right of navigation although he may build wharves which do not interfere with that right. Unlike bed-ownership problems, the public right of navigation does not require the application of federal law. Therefore the Indiana common-law test of navigability is applied. Although there may be some differences between public rights in lakes and those recognized in streams, Indiana seems to make no distinction between lakes, ponds, and streams with respect to riparian rights. (See W70-04857). (Marsee-Florida)

W70-04862

INDIANA WATER LAW AND SUGGESTIONS FOR ACTION,
G. Graham Waite.
Indiana Res Study Committee, p 25-30, 1968.

Descriptors: *Indiana, *Surface runoff, *Repulsion (Legal aspects), *Riddance (Legal aspects), Judicial decisions, Legal aspects, Runoff, Drainage water, Overland flow, Surface drainage, Surface waters, Drainage, Impounded waters, Impoundments, Diversion, Water pollution, Great Lakes Region, Water rights, Relative rights, Land use, Real property, Alteration of flow.

The distinguishing characteristic of diffused surface water is that it has no definite banks or channel as does surface water. Indiana follows the general rule that diffused surface water belongs to the person who captures and collects it on his land. Most of the legal problems related to diffused surface water involve attempts by landowners to rid themselves of such water by altering the natural drainage pattern so as to divert the water onto another's land. The liability of a landowner for such alteration in Indiana is determined by the common-enemy rule, subject to several modifications. The early common-enemy rule gave an owner unqualified right to do what he wished with diffused surface water including altering its course. This rule has been qualified in Indiana so that: (1) a landowner may not collect and then discharge such water; (2) a lower landowner may not collect surface water in an artificial channel and force it back upon upper land; (3) a landowner may not concentrate nor increase the flow onto other's land; and (4) he may not pollute such water. (See W70-04857). (Marsee-Florida)
W70-04863

INDIANA WATER LAW AND SUGGESTIONS FOR ACTION,
G. Graham Waite.
Indiana Res Study Committee, p 30-40, 1968.

Descriptors: *Indiana, *Groundwater, *Overlying proprietor, *Percolating water, Underground streams, Legal aspects, Judicial decisions, Relative rights, Water utilization, Subsurface waters, Underflow, Groundwater basins, Groundwater movement, Hydrologic cycle, Soil water, Reasonable use, Water rights, Reservoirs, Underground, Water sources.

A brief introduction to the law of groundwater is given, noting the distinction often made between underground streams and percolating water. Three doctrines define private rights to groundwater. The 'absolute ownership' doctrine holds that groundwater is part of the land on which it is found, and that the landowner has an absolute right to the water, provided he does not maliciously injure his neighbor. The 'reasonable use' doctrine, also proceeds upon the assumption that groundwater is part of the land; it limits the landowner to reasonable use of the water. The 'correlative rights' doctrine gives all owners of land over a common supply of groundwater correlative rights to the reasonable use of such water, provided they use it on overlying lands. In Indiana, the law of groundwater is unsettled. Early cases adopted the absolute ownership view. However, the later case of Gagnon v French Lick Springs Hotel Co., 163 Ind 687, 72 NE 849 (1904) makes it unclear whether Indiana still follows that view. An analysis of the case indicates that it probably has not changed the earlier Indiana law. (See W70-04857). (Marsee-Florida)
W70-04864

INDIANA WATER LAW AND SUGGESTIONS FOR ACTION,
G. Graham Waite.
Indiana Res Study Committee, p 40-54, 1968.

Descriptors: *Indiana, *Water rights, *Prescriptive rights, *Adjudication procedure, Conjunctive use, Natural flow doctrine, Riparian rights, Competing uses, Land tenure, Legal aspects, Judicial decisions, Relative rights, Water law, Water transfer, Water utilization, Consumptive use, Spring waters, Artificial precipitation, Water sources, Public rights, Damages.
Identifiers: Injunctions.

There are no Indiana cases dealing with: (1) the right to use spring waters; (2) the right to use artificially developed waters; (3) rights affected by rainmaking; or (4) the effect upon water rights of the interrelationship of water sources. In Indiana, water rights may be acquired by prescription except that there may be no acquisition of a prescriptive right in public waters. The elements of prescription in Indiana are discussed. Two examples of prescriptive water rights recognized in Indiana are the acquisition of an easement for drainage across another's land, and a right to maintain an unnatural condition which affects a watercourse. Certain prescriptive rights problems relating to consumptive use by riparian and non-riparian owners have not yet arisen in Indiana. Rights to water in Indiana may be conveyed separately, but these rights pass with the land unless reserved by the land's transferor. Indiana case law has recognized the following remedies to protect water rights: (1) damages; (2) injunction; (3) summary abatement or self-help; (4) apportionment or partition; and (5) declaratory judgment. (See W70-04857). (Marsee-Florida)
W70-04865

INDIANA WATER LAW AND SUGGESTIONS FOR ACTION,
G. Graham Waite.
Indiana Res Study Committee, p 77-92, 1968.

Descriptors: *Indiana, *Public rights, *Navigation, *Judicial decisions, Legal aspects, Water law, Recreation, Fishing, Navigable waters, Lake Michigan, State governments, Non-consumptive use, Riparian rights, Transportation, Water allocation (Policy), Lakes, Streams, Rivers, Watercourses (Legal), Streambeds, Riparian waters, Navigable rivers, Relative rights, Ice.
Identifiers: Northwest Ordinance.

Public water rights in Indiana are outlined within the framework of early and recent judicial developments, with special emphasis on key cases. Early cases almost invariably dealt with commercial, as opposed to recreational, navigation. These cases viewed the Northwest Ordinance as prohibiting physical obstructions of navigable watercourses. Today, court-made public rights in water exist in watercourses which are susceptible to commercial navigation. The Indiana courts have not customarily used the trust doctrine in judicially defining public rights. Public rights are not paramount to all private or state activities; the courts tend to take a balancing-of-interests approach. Thus, state authorized uses may be allowed at the expense of public rights. With a few exceptions, public rights in water do not limit riparian uses of the banks that do not physically obstruct navigation. The common-law public right includes removing sand from Lake Michigan's bed and probably from other streambeds. It probably includes recreational uses as well, although there has been no specific judicial determination of this. The public right is expressed as an easement of passage free from artificial obstruction. (See W70-04857). (Marsee-Florida)
W70-04866

INDIANA WATER LAW AND SUGGESTIONS FOR ACTION,
G. Graham Waite.
Indiana Res Study Committee, p 92-108, 1968.

Descriptors: *Indiana, *Legislation, Public rights, *Riparian rights, Lakes, Rivers, Streams, Riparian land, Ditches, Recreation, Recreation demand, Legal aspects, State governments, Navigable waters, Non-navigable waters, Impoundments, Consumptive use, Non-consumptive use, Navigation, Lake Michigan, Lake shores.

Although there is little case law in Indiana concerning public rights in water, there are many statutes. In 1955, water in any natural watercourse which may be applied to any 'useful and beneficial purpose' was declared to be public water of the state and subject to legislative regulation for the public welfare. It is unclear whether the phrase 'useful and beneficial' purposes includes recreation; however, two 1947 statutes declaring public rights broadly indicate that the right of recreation is a public right in water. The 1955 statute did limit the public right by subordinating such right to domestic uses and impoundments by riparian owners. The 1947 statutes do not make public rights depend on navigability. Apparently any use by the public is sufficient if acquiesced in by any riparian. This creates a constitutional problem concerning the exercise of the state's police power. Other statutes deal with: (1) zoning lakes for public use; (2) the power of county commissioners to declare waters in their counties navigable; and (3) the empowering of town trustees to determine and regulate the banks, shores, and wharves of any stream within the corporate limit. (See W70-04857). (Marsee-Florida)
W70-04867

INDIANA WATER LAW AND SUGGESTIONS FOR ACTION,
G. Graham Waite.
Indiana Res Study Committee, p 120-210, 1968.

Descriptors: *Indiana, *Administrative agencies, *State governments, *Water resources development, Legal aspects, Coordination, Institutions, Organizations, Permits, Regulation, Water allocation (Policy), Water rights, Public rights, Administration, Water law, Administrative decisions, Adoption of practices, Decision making, Leadership, Legislation, Judicial decisions, Standards, Water policy, Water zoning, Political aspects.

The impact of administrative agencies and local government units on Indiana water law is considered. The development of Indiana statutory law is discussed in light of: (1) the shift in water policy-making from local to state units of government; (2) the supplanting of court-made doctrine with legislation as a basis for determining important private and public rights in water; (3) and the emphasis placed on research by the Indiana Water Resources Study Committee. Two important Indiana water administrative agencies, the Division of Water of the Department of Natural Resources and the Stream Pollution Control Board, are discussed with emphasis placed upon the powers, responsibilities, and sources of authority of the former. Also discussed are the general administrative structures of the two agencies, and those integrating factors which draw the agencies together. Consideration is given to other state agencies with powers relating to water use, including the State Board of Health and the Public Service Commission. (See W70-04857). (Marsee-Florida)
W70-04868

INDIANA WATER LAW AND SUGGESTIONS FOR ACTION,
G. Graham Waite.
Indiana Res Study Committee, p 210-262, 1968.

Descriptors: *Indiana, *Local governments, *Coordination, *State governments, Zoning, Legal aspects, Legislation, Municipal water, Water law, Political aspects, Public rights, Judicial decisions, Conservation, Water districts, Governments, Navigable waters, Lakes, Drainage, Assessment, Non-navigable waters, Flood control, Administrative agencies.
Identifiers: Counties, Public trust.

An examination is made of the role of local government in shaping water rights in Indiana. Areas which are discussed include: (1) the working relationships between local units and state agencies in the water field; (2) statutory delegation of water-related powers to local units; (3) Indiana's conservancy districts; (4) the delegability of the public

trust in navigable waters to local units; (5) municipal zoning and use of water; and (6) water use problems in the six Indiana counties of Marion, Delaware, Kosciusko, Knox, Washington, and Monroe. An appendix to the overall report discusses the scope of Indiana's Lake Level Act. (See W70-04857). (Marsee-Florida)
W70-04869

GOVERNMENTAL REFILLING OF LAKES AND PONDS AND THE ARTIFICIAL MAINTENANCE OF WATER LEVELS: MUST JUST COMPENSATION BE PAID TO ABUTTING LANDOWNERS,
Robert E. Beck.
Texas Law Review, Vol 46, no 2, p 180-212, Dec 1967. 33 p, 113 ref.

Descriptors: *Riparian rights, *Dry beds, *Water level fluctuations, *Accretion (Legal aspects), State governments, Banks, Riparian land, Navigable waters, Ownership of beds, Riparian waters, Riparian water loss, Bank stability, Lakes, Beds under water, Beds, Lake beds, Boundaries (Property), High water mark, Low water mark, Compensation, Water levels, Fluctuation, Bodies of water, Ponds, Recreation facilities, Water resources development.
Identifiers: *Water level maintenance.

With proposals for refilling and artificially maintaining water levels of lakes and ponds for recreation purposes, there arises the problem of compensation for riparian landowners who would have become entitled to alluvion that would have formed but for the refilling. The initial question is whether the riparian right to alluvion, especially the right to future alluvion, is property. Authority is split on the question of the right to alluvion as a vested right, so the decision must be one of policy. The interest of the state in its water resources is placed opposite the interests of the riparian in the land and in having access to the waters. Since a property right may exist, the state may argue that it has not damaged the riparian's property rights by relying on either its interests in the waters within the state or its ownership of the bed under the waters. Under certain circumstances the property right may be properly taken or damaged, but the problem of compensation is complicated by problems in predicting how much alluvion was lost and what its value would have been. (See also W70-04871 thru W70-04873). (Douberley-Florida)
W70-04870

GOVERNMENTAL REFILLING OF LAKES AND PONDS AND THE ARTIFICIAL MAINTENANCE OF WATER LEVELS: MUST JUST COMPENSATION BE PAID TO ABUTTING LANDOWNERS,
Robert E. Beck.
Texas Law Review, Vol 46, no 2, p 180-189, Dec 1967.

Descriptors: *Riparian rights, *Dry beds, *Water level fluctuations, *Accretion (Legal aspects), Flooding, Riparian land, Recreation facilities, Lakes, Beds, Lake beds, Boundaries (Property), Water levels, Bodies of water, Ponds, Recreation, Relative rights, Flood damage.
Identifiers: *Water level maintenance.

There have been proposals for refilling and artificially maintaining water levels of lakes and ponds for recreational purposes; these projects, however, often would result in flooding abutting land. One of the littoral rights of adjacent landowners is the right to alluvion bared by reliction and accretion. There is some question whether inundation caused by refilling or maintaining levels should be considered as a taking of property that would require compensation. Courts are split on whether the riparian right to alluvion, especially to future alluvion, is a vested property right. Cases that treat the right to alluvion as a property right do not deal with future alluvion. Many courts take a 'lump-sum' approach that considers all riparian rights together and attempts to put them into existing classifications of property interests. A 'separate-evaluation' approach is more useful. This approach looks at each component of riparian rights separately and classifies each separately. Some riparian rights might be treated as vested property rights if separately evaluated, while others would be considered only contingent. A few cases hold that the right to future alluvion is vested, but others reject it as a property right. (See 70-04870). (Douberley-Florida)
W70-04871

GOVERNMENTAL REFILLING OF LAKES AND PONDS AND THE ARTIFICIAL MAINTENANCE OF WATER LEVELS: MUST JUST COMPENSATION BE PAID TO ABUTTING LANDOWNERS,
Robert E. Beck.
Texas Law Review, Vol 46, no 2, p 190-195, Dec 1967.

Descriptors: *Riparian rights, *Accretion (Legal aspects), *Riparian land, *Dry beds, Bank stability, Water resources development, Prior appropriation, Recreation, Recreation facilities, Water sources, Groundwater, Acess routes, State governments, Riparian water loss, Water levels, Fluctuation, Water rights.

Some states do not include the right to future alluvion in their list of recognized riparian rights. The western states reject the concept of riparian rights altogether. The decision of whether the right is considered vested or is treated as a mere contingency is one of policy, requiring the interests of the state to be balanced against those of the individual. The state has an interest in the maximum use of water, especially in light of increasing demands on water for recreational purposes. The task of restoring water levels rests with the state as an exercise of its police power. The state either has an existing tangible public interest in some waters within its jurisdiction, or it may acquire authority through procedures similar to those used in establishing drainage districts. Since the low water levels were caused by a man-made deficit of water sources, it would not seem that the state should have to pay to restore those levels. The primary substantive right of the abutting landowner is the maintenance of his status as a riparian owner by maintaining access to the waterbody. That right would be retained by maintaining water levels. (See W70-04870). (Douberley-Florida)
W70-04872

GOVERNMENTAL REFILLING OF LAKES AND PONDS AND THE ARTIFICIAL MAINTENANCE OF WATER LEVELS: MUST JUST COMPENSATION BE PAID TO ABUTTING LANDOWNERS,
Robert E. Beck.
Texas Law Review, Vol 46, no 2, p 195-212, Dec 1967.

Descriptors: *Riparian rights, *Dry beds, *Water level fluctuations, *Accretion (Legal aspects), High water mark, Low water mark, Navigable waters, Ownership of beds, Low-flow augmentation, State governments, Beds under water, Beds, Lake beds, Boundaries (Property), Compensation, Water levels, Fluctuation, Lake morphology, Lake shores, Damages, Erosion, Flood damage, Reasonable use.

The law regarding formation of alluvion is not an impediment to the state in most cases. The permanent drying up of the bed is not necessarily enough for the riparian owner to acquire rights to alluvion. The recession must be permanent, gradual and imperceptible. States may assert that there has been no taking of property by alleging either a paramount property right or by a valid exercise of the police power. Either argument requires balancing public and private interests. Each state has an interest in at least some waters within its boundaries. Levels may be artificially maintained to promote navigation, and this may be extended to include recreational uses. Further, states own at least some beds, usually under navigable waters, and maintaining the water level is a reasonable use of that bed, assuming the bed extends to the high water mark. Just compensation is difficult to determine because a determination of how much alluvion the owner has lost is highly speculative. Further, since title is frequently not quieted, value is difficult to determine. (See W70-04870). (Douberley-Florida)
W70-04873

WATER RIGHTS IN TENNESSEE,
Mahlon L. Townsend.
Tennessee Law Review, Vol 27, No 4, p 557-568, Summer 1960. 12 p, 98 ref.

Descriptors: *Ownership of beds, *Navigable rivers, *Subsurface waters, *Accretion (Legal aspects), Beds under water, Streambeds, Boundaries (Property), Low water mark, Non-navigable waters, Riparian rights, Natural flow doctrine, Alteration of flow, Civil law, Diversion, Surface drainage, Percolating water, Underground streams, Riparian land, Obstruction to flow, Reasonable use, Water pollution, Bank erosion, Dams, Natural flow, River flow, Access routes.

In Tennessee, water rights and riparian rights depend upon the navigability of the waterbody. Generally, the public retains substantial rights in navigable waters. The owner's title to riparian land may change by virtue of gradual changes due to erosion and accretion, but not by avulsion. The reasonable use doctrine applies to all riparian owners adjacent to running streams. Streams may be dammed or diverted, so long as there is no injury to other owners or substantial inconvenience to navigation. Diffused surface waters belong to owners of the beds beneath them. Natural flow from higher lands may not be obstructed, although damage caused by unnatural discharges is actionable. Underground streams are subject to the same laws as surface streams. The correlative rights doctrine applies to percolating waters that do not flow in an established channel. (See also W70-04875 and W70-04876). (Douberley-Florida)
W70-04874

WATER RIGHTS IN TENNESSEE (FLOWING STREAMS),
Mahlon L. Townsend.
Tennessee Law Review, Vol 27, No 4, p 557-564, Summer 1960. 7 p, 65 ref.

Descriptors: *Tennessee, *Surface waters, *Running waters, *Riparian rights, Navigable rivers, Streams, Bank erosion, Streambeds, River beds, Navigable waters, Stream erosion, Ownership of beds, Natural flow, Alteration of flow, River flow, Low water mark, Obstruction to flow, Civil law, Non-navigable waters, Riparian waters, Navigation, Reasonable use, Accretion (Legal aspects), Boundaries (Property), Water pollution.
Identifiers: Navigability in fact.

A stream is legally or technically navigable if it meets the civil law test; that is, if it is suitable for the usual purposes of navigation. A stream not legally navigable may become navigable in fact when flooding raises the water level. The public owns the beds of legally navigable streams; the title of riparian owners extends to the ordinary low water mark. Title to the bed of a stream only navigable in fact is in the riparian owners, subject to a public easement for navigation. A stream not navigable at all is subject to private ownership. Accretion deposited gradually becomes the property of the riparian owner, but he may lose land by erosion. Land may become riparian because of erosion, and it does not lose that status if accretion restores eroded land. Title to riparian land does not change because of rapid avulsion. A stream navigated by the public for more than twenty years may not be obstructed unless a greater public benefit is created by the obstruction. The reasona-

ble use doctrine applies to use of water by riparian owners, and reasonable diversions are allowed. A riparian owner may construct dams, but not so as to injure other riparian owners. All pollution is unlawful. (See W70-04874). (Douberley-Florida)
W70-04875

WATER RIGHTS IN TENNESSEE (DIFFUSED SURFACE WATERS AND UNDERGROUND WATERS),
Mahlon L. Townsend.
Tennessee Law Review, Vol 27, No 4, p 564-568, Summer 1960. 5 p, 33 ref.

Descriptors: *Tennessee, *Surface runoff, *Surface waters, *Subsurface waters, Drainage, Drainage water, Repulsion (Legal aspects), Riddance (Legal aspects), Standing waters, Overland flow, Surface drainage, Natural flow, Discharge (Water), Prior appropriation, Excess water (Soils), Precipitation excess, Easements, Obstruction to flow, Flooding, Percolation, Underground streams, Percolating water, Channels, Reasonable use.

Diffused surface waters are those not in natural streams or channels; they flow over the land, usually following precipitation. Such waters belong to the owner of the land. The owner of an upper tract has an easement on the lower tract for drainage of diffused surface waters. The flow cannot be obstructed so as to overflow the higher land. The upper owner may not discharge unnatural quantities of water onto the lower land. Damage to a building caused by water drainage from an adjacent building is actionable. Rights to surface waters may be acquired or lost by prescription and transferred by conveyance. Underground flowing streams are subject to the law applicable to surface streams. Unless the channel is established, the waters are presumed to be percolating, and the correlative rights doctrine is applied to them. The landowner is entitled to reasonable use of the water percolating through his land. The owner of a spring or well is entitled to damages for both surface and underground pollution. (See W70-04874). (Douberley-Florida)
W70-04876

PRESENT AND PROPOSED LEGAL CONTROL OF WATER RESOURCES IN WISCONSIN,
Glenn R. Coates.
Wisconsin Law Review, Vol 1953, no 2, p 256-296, Mar 1953. 41 p, 102 ref.

Descriptors: *Wisconsin, *Water conservation, *Water demand, *Water allocation (Policy), Water supply, Water distribution (Applied), Administration, Permits, Legal aspects, Water sources, Competing uses, Riparian rights, Reasonable use, Water policy, Domestic water, Industrial water, Recreation, Irrigation practices, Legal aspects, Surface waters, Surface irrigation, Administrative agencies, Regulation.

Conflict over water use continues to increase between irrigators and sportsmen. The former desire further consumptive use of water, while the latter oppose any dimunition of surface waters which might endanger marine life and recreation. Irrigation has recently expanded from specialty crops to grains and pastures, increasing the demand on the state's water supply. The growing Wisconsin tourist industry, on the other hand, depends to a great extent upon fishing and other water recreation. Other increases in domestic and industrial consumptive uses further complicate the problem. A review of legislation and common law water rights doctrine reveals that little has been done to uniformly regulate the competing demands upon the water supply. The author suggests adoption of the Water Diversion Act, which places authority to deal with competing uses that result in water diversion under a public service commission. Generally, permits would be required before water could be diverted from water courses or ground sources, and an overall policy of water allocation could be developed. There is evidence that sufficient economic necessity exists to support the constitutionality of this type of water control under the Wisconsin Constitution. (See also W70-04878 thru W70-04880). (Kelly-Florida)
W70-04877

PRESENT AND PROPOSED LEGAL CONTROL OF WATER RESOURCES IN WISCONSIN (RIPARIAN RIGHTS AND SURFACE WATERS),
Glenn R. Coates.
Wisconsin Law Review, Vol 1953, No 2, p 263-268, Mar 1953.

Descriptors: *Wisconsin, *Water rights, *Riparian rights, *Surface waters, Water demand, Reasonable use, Water policy, Water allocation (Policy), Competing uses, Relative rights, Streamflow, Natural flow, Administration, Judicial decisions, Legal aspects, Legislation, Regulation, Permits.

Surface waters may be defined as waters flowing continuously or intermittently in natural surface channels from definite sources of supply, and waters flowing through lakes, ponds, and marshes which are integral parts of a stream system. The flow must be of sufficient quantity to form a bed and banks. In Wisconsin, the existence of a watercourse is a question of fact for the jury. Wisconsin has exclusively adopted the doctrine of riparian rights. An owner of land contiguous to a watercourse has a right to have the water flow by or through his land substantially undiminished in quantity or quality, subject to an upper riparian owner's right to make reasonable use of the water as it flows by his land. The riparian right cannot be taken for a public purpose without compensation. Legislation gives the riparian owner full protection of his right to natural flow, but prohibits consumptive use of the water without a Public Service Commission permit. Legislation also protects public water rights. The author suggests that protective legislation has substantially diminished the privilege of reasonable use. (See W70-04877). (Kelly-Florida)
W70-04878

PRESENT AND PROPOSED LEGAL CONTROL OF WATER RESOURCES IN WISCONSIN (DOCTRINE OF PRIOR APPROPRIATION),
Glenn R. Coates.
Wisconsin Law Review, Vol 1953, no 2, p 268-270, Mar 1953.

Descriptors: *Wisconsin, *Prior appropriation, *Water rights, *Beneficial use, Adjudication procedure, Appropriation, Diversion, Administrative agencies, Preferences (Water rights), Industrial water, Legal aspects, Legislation, Permits, Irrigation water, Priorities, Reasonable use, Remedies, Water utilization, Usufructuary right, Regulation.

The doctrine of prior appropriation has been recognized and enforced by the courts of some states in deference to well recognized practices by laymen in a number of Western states. The doctrine provides that the right to use water arises from a diversion of water plus application of that diverted to beneficial use. Priority in time gives the better right, and location of land in respect to the watercourse is not a factor. Some states adapting this doctrine require that applications for permits be made to the state engineer before diversion of water may be commenced. The doctrine of prior appropriation is thought to be preferable to the riparian doctrine in encouraging efficient water use. There are faults in the former doctrine, however, which permit an early appropriator to divert a greater amount of water than he can efficiently use, so long as his use is beneficial. The author suggests that increased administrative regulation and more emphasis on beneficial use rather than priority would make the doctrine more workable. (See W70-04877). (Kelly-Florida)
W70-04879

PRESENT AND PROPOSED LEGAL CONTROL OF WATER RESOURCES IN WISCONSIN (DIFFUSED SURFACE WATERS; GROUNDWATER; AND A PROPOSED WATER DIVERSION ACT),
Glenn R. Coates
Wisconsin Law Review, Vol 1953, No 2, p 270-296, Mar 1953.

Descriptors: *Wisconsin, *Groundwater, *Water rights, *Surface runoff, Surface-groundwater relationships, Drainage water, Base flow, Groundwater movement, Prescriptive rights, Water wells, Water supply, Water demand, Administration, Water distribution (Applied), Legal aspects, Regulation, Impoundments, Legislation, Reasonable use.

Diffused surface waters occur on the surface of the earth in places other than defined water courses, lakes, or ponds. Riparian rights do not attach to such waters. Judicial difficulties have arisen in Western states with regard to the impounding of diffused surface water which is the source of supply for a watercourse. Groundwater is construed in Wisconsin to exclude defined underground streams. Groundwater includes only percolating waters, and underground streams are treated in the same manner as surface water. A landowner may withdraw all the water he wishes by wells on his own land under Wisconsin common law. The legislature has curtailed this unrestricted use, however, and requires permits to be obtained before more than a certain daily volume of water may be withdrawn. Other states have adopted a reasonable use limitation under common law. Some states have extended appropriation principles to all groundwater, giving the greatest right to owners of the land overlying the supply. It is contended that the Wisconsin rule gives approval to destruction of groundwater levels through individual waste. (See W70-04877). (Kelly-Florida)
W70-04880

REPORT OF THE SELECT COMMITTEE ON WATER RESOURCES (FLORIDA'S WATER PROBLEMS).
For primary bibliographic entry see Field 05G.
W70-04881

REPORT OF THE SELECT COMMITTEE ON WATER RESOURCES (INDUSTRIAL AND DOMESTIC POLLUTION).
For primary bibliographic entry see Field 05G.
W70-04882

REPORT OF THE SELECT COMMITTEE ON WATER RESOURCES (FOREIGN MATTER AND SALT WATER INTRUSION IN PUBLIC WATERS).
For primary bibliographic entry see Field 05G.
W70-04883

REPORT OF THE SELECT COMMITTEE ON WATER RESOURCES, (FLOOD PLAIN AREAS AND WATER STORAGE LANDS).
For primary bibliographic entry see Field 05G.
W70-04884

REPORT OF THE SELECT COMMITTEE ON WATER RESOURCES (WELL DRILLING, HARD DETERGENTS, CODIFICATION OF DRAINAGE LAWS).
For primary bibliographic entry see Field 05G.
W70-04885

REPORT OF THE SELECT COMMITTEE ON WATER RESOURCES (PROPOSED STATUTES).
For primary bibliographic entry see Field 05G.
W70-04886

NATIONAL POLICY PROBLEMS IN WATER RESOURCES.
American Society of Civil Engineers. Washington, D.C. National Capitol Section.
For primary bibliographic entry see Field 06B.
W70-04978

6F. Nonstructural Alternatives

RATIONAL INVESTMENT BEHAVIOR IN THE FACE OF FLOODS,
California Univ., Berkeley. Center for Research in Management Science.
C. B. McGuire.
Available from the Clearinghouse as PB-190 270, $3.00 in paper copy, $0.65 in microfiche. California University Center for Research in Management Science, Final Report for period July 1967-March 1969. 142 p, 13 fig, 62 ref, 2 append. OWRR Proj No C-1120.

Descriptors: *Statistical models, *Non-structural alternatives, *Flood plains, *Beneficial use, *Simulation analysis, Stochastic processes, Mathematical models, Dynamic programming, Systems analysis, Social aspects, Legal aspects, Economics, Flood damage, Flood plain zoning, Planning, Probability, Investment.
Identifiers: Flood plain use.

An economic, stochastic model was studied for predicting rational investment behavior in the face of floods. A computable model was made of people's reactions, in terms of economic decisions, to changes in such things as flood control policies, flood relief policies, flood insurance, information (or beliefs) about floods and damages, production technology, available economic activities, commodity prices, and interest rates. Together with hydrological data about the stochastic nature of flood occurrences, the model then may be made to serve either prescriptive or descriptive uses; that is, either (1) to tell a landowner how he ought to behave in terms of proper choice and management of the production activity on his land, or (2) to predict how a rational landowner will behave in these same terms. (Knapp-USGS)
W70-04689

6G. Ecologic Impact of Water Development

A STUDY OF SELECTED CHEMICAL AND BIOLOGICAL CONDITIONS OF THE LOWER TRINITY RIVER AND THE UPPER TRINITY BAY,
Texas A and M Univ., College Station. Water Resources Inst.
For primary bibliographic entry see Field 02L.
W70-04687

07. RESOURCES DATA

7A. Network Design

THE U. S. GEOLOGICAL SURVEY URBAN WATER PROGRAM,
Geological Survey, Washington, D.C. Water Resources Div.
For primary bibliographic entry see Field 04C.
W70-04573

SENSOR DETECTION CAPABILITIES STUDY,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07B.
W70-04592

HYDROLOGIC DATA FOR RESERVOIR DESIGN,
Geological Survey, Washington, D.C.
H. C. Riggs.
French resume included. In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 540-550, 1966. 11 p, 8 fig, 14 ref.

Descriptors: *Streamflow forecasting, *Reservoir design, *Data collections, *Surveys, Networks, Stream gages, Gaging stations, Climatic data, Hydrologic data, Water storage, Reservoirs.
Identifiers: *Reservoir design data.

Definition of a draft-storage relation should be based on a streamflow record of considerable length from a network of stream gaging stations. However, because few gaging stations are located at sites subsequently selected for reservoirs, a streamflow inventory of a region, suitable for use in reservoir design, must include information which will permit development of draft-storage relations anywhere in the region. Draft-storage characteristics can be related to the within-year variability of streamflow and to the mean and variability of annual mean flows. Such relations defined from gaging station records, can be applied to other sites at which the variables in the relation can be estimated. Within-year variation can be represented by the median annual low flow which can be estimated from a few base flow measurements. Methods are given for estimating the mean and variability of annual mean flow from both humid and semi-arid basins. Examples of each of the methods described above show that the results are adequately reliable for design bases. A suitable data-collection network would consist of stream gaging stations, base flow discharge measurements at many sites, sediment and chemical-quality sampling stations, and climatological stations. (Knapp-USGS)
W70-05026

7B. Data Acquisition

USE OF TRACERS IN HARBOR, COASTAL AND OCEAN ENGINEERING,
Norges Tekniske Hoegskole, Trondheim. Dept. of Port and Ocean Engineering.
P. Bruun.
Engineering Geology, Vol 4, No 1, p 73-88, January 1970. 16 p, 24 fig, 1 tab, 33 ref.

Descriptors: *Tracers, *Tracking techniques, Radioactivity techniques, Bibliographies, Dye releases, Sediment transport, Tagging, Analytical techniques, Fluorescence, Marking techniques, Flow, Hydraulics.
Identifiers: Tracer techniques.

The uses of tracers in ocean, harbor, coastal, and river engineering are described. Some applications of tracers in pollution control are described in detail. Tracers and analytical techniques used in studying drift patterns and flow rates are listed. A bibliography of theoretical and practical references is included. (Knapp-USGS)
W70-04551

DETERMINATION OF SELENIUM BY THE RING OVEN TECHNIQUE,
Missouri Univ., Kansas City. Dept. of Chemistry.
Donald W. Dickey, James H. Wiersma, Russell G. Barnekow, Jr., and Peter F. Lott.
German summary included. Mikrochimica Acta, Vol 3, p 605-610, 1969. 6 p, 1 tab, 8 ref. OWRR Proj No A-009-MO, NIH Grant GM 12830-02.

Descriptors: *Chemical analysis, *Trace elements, Geochemistry, Water chemistry, Water analysis, Toxicity, Water pollution effects, Soil contamination effects.
Identifiers: *Selenium.

A simple semi-quantitative fluorometric method for selenium analysis has been developed which employs the reagent 2,3-diaminonaphthalene and the ring oven technique. By this procedure selenium can be determined to 10 ppb; the optimum working range is 20-80 ppb. The concentration of selenium is ascertained by visual observation of the rings under long wavelength UV light. (Knapp-USGS)
W70-04561

SENSOR DETECTION CAPABILITIES STUDY,
Geological Survey, Washington, D.C.
John E. Wilson.
Report available free on application to the U S Geological Survey, Washington, D C 20242. Geological Survey Circular 616, 1969. 26 p, 7 fig, 1 tab, 25 ref. NASA Contract No W-12570, task No 160-75-01-31-10.

Descriptors: *Remote sensing, *Aerial photography, *Radar, *Exploration, Surveys, Investigations, Water resources, Research and development, Evaluation, Resource development, Resources, Natural resources, Water resources.
Identifiers: Remote sensor capabilities.

Ten sensors used in collecting data for earth resources studies were investigated and rated. Four major variables which affect the selection of an appropriate sensor are: (1) Target and background identity; (2) Sensor availability; (3) Sensor capabilities and characteristics; and (4) Data collection system economics. Sensor records that were viewed and rated included: (1) Black and white photography; (2) Color photography; (3) Infrared (IR) color photography; (4) Black and white infrared photography; (5) 2- to 4-micron thermal infrared imagery; (6) 8- to 14-micron thermal infrared imagery; (7) Side-looking radar (SLAR) imagery; (8) Electro-optical (television) imagery; (9) Imaging microwave imagery; and (10) Nonimaging scatterometer data. Of the 98 targets considered in this evaluation, 89 indicated that a photographic system held the greatest promise of object detection. Infrared, side-looking radar, scatterometer, and passive microwave each were capable of significant contributions over one or more of the listed targets. (Knapp-USGS)
W70-04592

HYDRAULIC TESTING AND SAMPLING OF USBM-AEC COLORADO CORE HOLE 3, RIO BLANCO COUNTY, COLORADO,
Geological Survey, Denver, Colo.
For primary bibliographic entry see Field 02F.
W70-04598

RECOMMENDATIONS FOR TESTING CONCRETE BY THE ULTRASONIC PULSE METHOD,
For primary bibliographic entry see Field 08F.
W70-04620

RECOMMENDATIONS FOR THE USE OF RESONANCE METHODS FOR TESTING CONCRETE,
Institute for Building Technics, Warsaw (Poland).
For primary bibliographic entry see Field 08F.
W70-04621

SONIC POLE TESTS PROVE RELIABLE AND INEXPENSIVE,
Detroit Edison Co., Mich.
For primary bibliographic entry see Field 08C.
W70-04622

THE APPLICATION OF A DIGITAL COMPUTER TO MECHANICAL TESTING,
Union Carbide Corp., Oak Ridge, Tenn.
For primary bibliographic entry see Field 08G.
W70-04624

AIRPHOTO INTERPRETATION OF FLOOD PLAIN SOILS,
Wisconsin Univ., Madison.
For primary bibliographic entry see Field 08D.
W70-04630

MEASURING MOISTURE WITH GAMMA RADIATION,
For primary bibliographic entry see Field 08G.
W70-04641

DISCHARGE MEASUREMENTS USING THE RADIOISOTOPE VELOCITY, INTEGRATED SAMPLE, DILUTION, AND TOTAL COUNT METHODS AT FLATIRON POWER AND PUMPINS PLANT, COLORADO-BIG THOMPSON PROJECT,
Bureau of Reclamation, Denver, Colo.
For primary bibliographic entry see Field 08C.
W70-04645

A NEW METHOD TO DETERMINE THE SPHERICITY OF MOBILE SEDIMENTS,
Centre Universitaire Marseille-Luminy, Marseille (France). Geology Lab.
For primary bibliographic entry see Field 02J.
W70-04731

AUTOMATIC METHODS FOR THE ANALYSIS OF NATURAL WATERS,
Wisconsin Univ., Madison. Water Chemistry Lab.
G. Fred Lee.
Proceedings of International Biological Program Symposium Held in Amsterdam and Nieuwersluis, Netherlands, October 10-16, 1966. Chemical Environment in the Aquatic Habitat, G L Golterman and R S Clymo, editors, N V Noord-Hollandsche Uitgevers Maatschappij, Amsterdam, 1967. p 169-180. 2 fig, 1 tab, 32 ref, Comment.

Descriptors: *Chemical analysis, *Water chemistry, *Instrumentation, Alkylbenzene sulfonates, Colorimetry, Volumetric analysis, Limnology, Monitoring, Water pollution, Water quality, Phosphates, Chlorides, Bicarbonates, Carbonates, Hydrogen ion concentration, Calcium, Magnesium, Chemical oxygen demand, Dissolved oxygen, Sulfates, Organic acids, Flame photometry, Fluorometry, Nutrients, Vitamins, Enzymes.
Identifiers: *Automated methods, Data acquisition, Electrometric methods, Technicon AutoAnalyzer, Fisher Scientific Automatic Titrator, Coulometry, Conductometry, Atomic absorption spectroscopy.

Water pollution monitoring and limnochemical research programs often require chemical analyses of large numbers of samples. Automated procedures for colorimetry and electrometry have been used and offer even greater promise for the future. In a typical colorimetric application, the Technicon AutoAnalyzer, key development of which is a reliable proportionating pump, assemblages of various modules make possible analyses involving diverse manipulations including distillation, solvent extraction, dialysis, and precipitation. Possibility of replacing colorimeter with other detectors (flame photometer, atomic adsorption spectrophotometer, continuous flow fluorometer) insures greater flexibility. A table of 40 water analyses which have been automated includes procedures diverse as alkyl benzene sulfonates, chemical oxygen demand, plant nutrients, and various vitamins and enzymes. Example of an automated phosphate analysis is described in detail. Automated procedures may permit greater precision, and, due to careful control of conditions at each step, may allow use of reactions which do not proceed to completion. Automatic and semi-automatic titrations are also effective. The paper describes a European example of titrimetry which permits nine separate analyses. Future developments in automation will include self-contained monitoring stations for collection of limnological data. A list of American equipment manufactures is included. (See W70-04821). (Eichhorn-Wisconsin)
W70-04822

DETERMINATION OF VITAMINS IN SEAWATER,
California Univ., San Diego, La Jolla. Inst. of Marine Resources.
A. F. Carlucci, and S. B. Silbernagel.
Proceedings of International Biological Program Symposium held in Amsterdam and Nieuwersluis, Netherlands, October 10-16, 1966. Chemical Environment in the Aquatic Habitat, Golterman, H L and Clymo, R S, editors, N V Noord-Hollandsche Uitgevers Maatschappij, Amsterdam, 1967, p 239-244. 2 tab, 12 ref.

Descriptors: *Vitamins, *Bioassays, *Sea water, Organic matter, Carbon radioisotopes, Algae, Physiological ecology, Water pollution effects, Diatoms, Yeasts, Dinoflagellates, Aquatic bacteria, Oceanography, Pacific Ocean, Biomass, Zooplankton, Chlorophyll, Bioindicators.
Identifiers: *Organic solutes, Vitamin B-12, Thiamine, Biotin, Radiocarbon uptake techniques, Algal enumeration, Microbial ecology, Data acquisition, Cyclotella nana, Gyrodinium cohni, Phycomycetes, Isolate S-3, Cryptococcus albidus, Monochrysis lutheri, Amphidinium carteri.

A variety of microorganisms have been used in bioassays for minute concentrations of ecologically important vitamins (B-12, biotin, thiamine) dissolved in the hydrosphere. Assay procedures are outlined for seawater in which radiocarbon uptake or cell numbers can be evaluated after incubation of organisms in nutrient-enriched media under carefully controlled conditions. Both internal standards, to assess seawater toxicity, and external standards, to establish a calibration curve, are utilized. Organisms employed in the assays (with effective assay ranges, in nanograms/liter, indicated in parentheses) are: B-12--Cyclotella nana (0.05-3); thiamine--Monochrysis lutheri (2-35); biotin--Amphidinium carteri (0.2-5). Data derived from such bioassays are reported for stations of the North Pacific Ocean along a transect from Kodiak, Alaska, to Honolulu, Hawaii. Ranges of concentrations (in nanograms/liter) reported are: B-12, undetectable-0.88; thiamine, 3.4-32.0; biotin, 1.0-3.0. Concentrations of vitamin B-12 are apparently inversely correlated with biomass of chlorophyll and zooplankton. Microbiological assays described here detect concentrations considerably lower than do methods described previously, and they are sensitive in ecologically important ranges. (See W70-04821). (Eichhorn-Wisconsin)
W70-04823

7C. Evaluation, Processing and Publication

RESOURCE CONSERVATION GLOSSARY,
For primary bibliographic entry see Field 10.
W70-04559

ACCURACY OF STREAMFLOW CHARACTERISTICS,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02E.
W70-04564

MODELING THE RUNOFF CHARACTERISTICS OF AN URBAN WATERSHED BY MEANS OF AN ANALOG COMPUTER,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 04C.
W70-04575

VOLUME TWO-TECHNICAL DEVELOPMENT PLAN, NATIONAL DATA PROGRAM FOR THE MARINE ENVIRONMENT.
System Development Corp., Santa Monica, Calif.

System Development Corporation Technical Memorandum TM-4023/006/00, July 31, 1969. 216 p, 11 fig, 58 tab, append. ONR Contract No N00014-67-C-0559.

Descriptors: *Data storage and retrieval, *Data processing, *Information retrieval, *Oceanography, Documentation, Management, Planning, Methodology, Project planning, Systems analysis, Technology, Marine geology.
Identifiers: Data systems, Data management.

The objective of the Technical Development Plan (TDP) is to improve marine data products and services provided by the Federal Government to a variety of users. The TDP recommends that products and services be improved both by enhancing existing products and services and by introducing new products and services. Recommendations are also made for increases in data acquisition, improvements in existing data bases and the development of new data bases. The mechanisms chosen for achieving greater benefits for users are (1) the upgrading of Federal agency data service and product operations and (2) the improvement of the marine data network for the collection, transmission, storage and dissemination of marine data. A 10-year, time-phased plan was designed to provide the resources necessary to achieve the improvements. The TDP includes provisions for new instrumentation and new data communication and processing hardware, hardware costs, software development and maintenance, software personnel and costs, computer operations personnel and costs, and application and discipline personnel and costs. (Knapp-USGS)
W70-04600

AN INVENTORY OF THE PONDS, LAKES, AND RESERVOIRS OF MASSACHUSETTS-BARNSTABLE COUNTY,
Bureau of Sport Fisheries and Wildlife, Amherst, Mass.
James A. McCann.
Water Resources Research Center, University of Massachusetts, Amherst, Publication 10-1, Dec, 1969. 102 p, 119 maps, 17 ref. OWRR Project A-999-MASS.

Descriptors: *Data collections, *Surveys, *Land use, *Water utilization, Fishing, Recreation, Water quality, *Massachusetts, Limnology.
Identifiers: *Cape Cod.

This is an inventory of the physical, biological and land-water use characteristics of all ponds, lakes, and reservoirs over five acres or identified on U.S. Geological topographic maps of Barnstable County, Massachusetts. Data from published sources or from official files of federal, state and regional water resources agencies were summarized, recorded on standard forms, coded, and keypunched on automatic data processing cards. The physical characteristics of the ponds were updated to include all standing bodies of water over five acres located on serial photographs taken in the spring of 1965.
W70-04651

A STATISTICAL SIMULATION TECHNIQUE FOR NORTHERN NEW JERSEY MONTHLY PRECIPITATION,
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Meteorology.
For primary bibliographic entry see Field 02B.
W70-04718

ANALYSIS OF WATERSHED CHANGES,
Hydrocomp International, Palo Alto, Calif.
Norman H. Crawford.
In: Effects of Watershed Changes on Streamflow Water Resources Symposium No 2, Austin, Texas, October 1968, p 27-34, University of Texas Press, Austin and London, 1969. 8 p, 4 fig, 2 tab, 6 ref.

Descriptors: *Model studies, *Simulation analysis, *Rainfall-runoff relationships, Urbanization, Computer models, Mathematical models, Statistical models, Routing, Runoff, Streamflow forecasting, Probability, Systems analysis.
Identifiers: Watershed models, Watershed changes.

Watershed changes can be classified by purpose as altering runoff volumes, flow duration characteristics, or floodflows. Changes in runoff volumes and changes in flow duration characteristics require land surface changes. Land surface changes occur in agricultural activities, in forest fires, and in urbanization. In general, the hydrologic effect of

land surface change is only one of many considerations. Deliberate land surface changes are seldom carried out for hydrologic benefits only; where farming practices are changed, agricultural as well as hydrologic benefits are sought. Hydrologic damages are seldom sufficient to prevent planned land surface activities. Digital computer hydrologic simulation is particularly helpful in interpreting land surface changes. Flows can be simulated before and after a change to find the effect of the change on infiltration rate and soil moisture storage. Channel system changes are well suited to analysis with current programming techniques. Interaction between land surface runoff sequences and channel network response can be easily studied for scores of combinations of physical works. This is most helpful in tracing physical interactions between several projects in a watershed. (See W70-04723). (Knapp-USGS)
W70-04728

SOME METHODOLOGICAL PROBLEMS OF INVENTORIES ON LAKES,
Research Inst. for Water Resources Development, Budapest (Hungary).
For primary bibliographic entry see Field 02H.
W70-04757

OPTIMUM WATER USE - A MULTIDISCIPLINARY APPROACH,
North Carolina Univ., Chapel Hill.
For primary bibliographic entry see Field 06A.
W70-04986

08. ENGINEERING WORKS

8A. Structures

JUDGMENT FACTORS IN INSPECTION OF DAMS,
Harza Engineering Co., Chicago, Ill.
Andrew Eberhardt.
Water Power, Vol 21, No 11, p 431-435, Nov, 1969. 5 p, 4 ref.

Descriptors: Decision making, *Inspection, *Dams, Earth dams, Concrete dams, Dam foundations, Spillway design flood, Design flood, Design data, *Safety, Safety factors, Risks, Hazards, Responsibilities, Operation and maintenance, Performance, Exploration, Investigations, Rehabilitation, Reliability.
Identifiers: *Engineering evaluation, Remedial treatment, Spillway capacity, Flood estimate.

Good engineering judgment is essential in designing dams, and may be more important in making decisions about the competency of existing dams. Several cases are cited, pointing out some problems and judgment factors involved in evaluating competency of existing dams. Problems discussed are: (1) lack of and unreliability of data about investigation, design, construction, and performance; (2) misleading appearances; (3) poor and incorrect operation and maintenance; (4) owners' uncooperation and judgments based on past successful performance; (5) design shortcomings; and (6) lack of money for investiations and remedial measures. Judgment-type decisions about dams require weighing against each other elements of safety, risk, cost, practical limitations, and possible damages. Every dam that impounds water presents a potential danger that should be neither underestimated nor overestimated; risk of sudden disaster is forever inescapable. There are challenges to accept, responsibilities to bear, and consequences to face in inspecting and designing dams. (USBR)
W70-04617

MECHANICAL STRUCTURES FOR FARM IRRIGATION,
Agricultural Research Service, Kimberly, Idaho. Snake River Conservation Research Center.
For primary bibliographic entry see Field 03F.
W70-04638

STRUCTURAL ANALYSIS BY COMPUTER GRAPHICS,
Lockheed-Georgia Co., Marietta.
William F. Bates, Jr., and William M. Cox.
Proc Amer Soc Civ Eng, J Struct Div, Vol 95, No ST11, p 2433-2448, Nov 1969. 16 p, 16 fig, 2 ref, 2 append.

Descriptors: *Computer models, *Computer programs, *Structural analysis, *Graphical analysis, Computers, Computer systems components, Structural design, Analysis, Data processing, Structural engineering, Structural models.
Identifiers: Computer-aided design, Computer capability, Man-machine systems, Matrix methods (Structural).

The emerging uses of computer graphics in structural engineering and design, especially in transferring numerical output into visual graphical form, are discussed. A 2-dimensional structure analysis program developed for a computer system at Lockheed-Georgia Laboratory is described. Civil engineering is a prime field for implementing computer graphics to reduce calculation time and quantity of input. Future expansion of computer graphics in engineering is described. Uses being developed include some that will display 3-dimensional structural arrangements and permit broader man-machine interaction in input and output phases. Also under development is the kinematic analysis of 3-dimensional mechanisms to optimize space requirements and maintain clearance. Computer graphics points the way toward better man-machine communication in all phases of design. (USBR)
W70-04643

SOME ESTIMATES OF THE THERMAL EFFECTS OF A HEATED PIPELINE IN PERMAFROST,
Geological Survey, Washington, D.C.
Arthur H. Lachenbruch.
Report available free on application to the US Geological Survey, Washington, DC 20242. Geological Survey Circular 632, 1970. 23 p 6 fig, 8 tab.

Descriptors: *Permafrost, *Melting, *Pipelines, *Alaska, Frozen ground, Frost heaving, Mud, Ice, Soil mechanics, Tundra, Engineering geology, Ecology.
Identifiers: Pipeline design, Permafrost engineering.

As one means of transporting crude oil from oil fields on the Alaskan Arctic coast to a year-round ice-free port, a large pipeline traversing most of the state of Alaska from north to south has been proposed. Plans call for a pipe 4 feet in diameter, which will be buried along most of the route in permafrost. The initial heat in the oil plus frictional heating in the pipe are expected to maintain oil temperatures in the neighborhood of 70 deg to 80 deg C (158 deg to 176 deg F). Such an installation would thaw the surrounding permafrost. Where the ice content of permafrost is not high, thawing by the buried pipe might cause no special problems. Under adverse local conditions, however, this thawing could have significant effects on the environment, and possibly upon the security of the pipeline. In this report a few basic principles are applied to simplified models of permafrost regimes to identify some effects of a heated pipe, the conditions that control them, and the approximate ranges of physical properties for which these effects are likely to result in problems. (Knapp-USGS)
W70-04694

STORAGE OF THE FLOODS OF SMALL WATERCOURSES, (IN FRENCH),
Transdanubian water Authority, Szekesfehervar (Hungary).
For primary bibliographic entry see Field 04A.
W70-04747

CONTROL OF SULFATE-REDUCING BACTERIA,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Microbiology Section.
For primary bibliographic entry see Field 05G.
W70-04813

RATIONAL ULTIMATE-STRENGTH COMPOSITE-BEAM ANALYSIS,
Missouri Univ., Columbia.
James W. Baldwin, Jr.
Report, University of Missouri, Columbia, Civil Engineering Dept, 1969. 22 p, 8 fig, 2 ref.

Descriptors: Shear strength, Shear forces, *Beams (Structural), Moment distribution, Compressive strength, Structural steel, Concretes, Stress analysis, Structural members, Structural engineering, Structural design, *Structural analysis, Analysis.
Identifiers: *Ultimate strength design, *Ultimate strength, *Composite beams, Hybrid beams, Shear connectors.

The moment capacity of a composite beam varies along the length of the beam, and the ultimate strength is not necessarily governed by the section at which maximum moment occurs. An ultimate strength analysis that allows computing ultimate moment capacity at any section of a concrete on steel composite beam is presented. The analysis can be applied to beams having partial length cover plates, unsymmetrical sections, hybrid sections, or any combination of these features. Computations for complete moment capacity diagrams are lengthy, but for design purposes, computations need be made only for sections likely to be critical. Generally, sections of maximum moment, sections at concentrated loads, and sections at abrupt changes in geometry should be investigated. Indiscriminately using uniform spacing of shear connectors may lead to unconservative design.
W70-04893

. . . THE ROMAN DAMS OF SUBIACO,
Imperial Coll. of Science and Technology, London (England).
Norman A. F. Smith.
Technology and Culture, Vol. 11, No. 1, p58-68, January 1970.

Descriptors: *Reservoirs, *Dam design, *Dam failure, Damsites, Recreation, Water supply, History.
Identifiers: Italy, Roman Empire.

In the Aniene valley above Subiaco, Italy, are the sites of three dams, constructed during the first century A.D., which are of great interest for three reasons: first, they were built primarily for recreational purposes related to the nearby villa of Nero; second, they were, as far as is known, the only dams which the Romans built in their own country; and third, one of them, was probably the highest dam, about 130 feet, in the Roman Empire and perhaps in the world until the Alicante dam, in Spain, of 1594. The dams apparently continued in use up to medieval times. The largest dam did not collapse until 1305, according to contemporary records, when two monks took stones from the dam in an attempt to lower the level of the impounded water which was flooding their lands. This articles discusses the probable damsites, remains, construction, and use in relation to ancient sources, a previous 19th century investigation, and a painting of 1428 in the monastery of Saint Benedict which seems to depict the saint fishing from the crest of the dam. A drawing based upon this painting is a part of the article and is also used as the front cover design for this issue of Technology and Culture. (Cowgill-OWRR)
W70-04980

THE IJSSEL LAKE AS A MULTI-PURPOSE RESERVOIR,
Zuider Zee Works (Netherlands). Hydrology Section.
C. H. De Jong.

French resume included. In: Hydrology of Lakes and Reservoirs, Symposium of Garda (Oct 9-15, 1966), International Association of Scientific Hydrology, Publication No 71, p 565-574, 1966. 10 p, 3 fig, 1 ref.

Descriptors: *Reservoirs, *Multiple-purpose reservoirs, *Drainage, *Water storage, *Land reclamation, Land management, Water levels, Water-level fluctuations, Canals, Pumping, Evaporation, Inflow, Hydrologic budget, Streamflow forecasting, Water quality.
Identifiers: *Netherlands, IJssel Lake, Polders.

The IJssel Lake is an important part of the Zuiderzee project, which is being carried out in the Netherlands to extend the land area by reclamation and to improve the water management of a large area around the lake. The lake has to satisfy various interests such as drainage of and water supply to surrounding areas, navigation, fishing, and recreation, each with its own demands with regard to the management of the lake. Since some of the adjacent areas have a ground level almost 5 m lower than mean sea level and are densely populated with increasing industrialization, inundation has to be prevented even under extreme circumstances of heavy storms and high water levels on the lake. The efficiency of the water management of the lake is judged by the level of the lake, the available amounts of water during droughts and the quality of the water. The variations of these factors depend on the size, normal level, and dimensions of the discharge sluices. They are interrelated via the equations of continuity for the water and the salt in the lake. The methods for the design of the lake are discussed. (Knapp-USGS)
W70-05027

8B. Hydraulics

VISUALIZATION OF SPIRAL MOTION IN CURVED OPEN CHANNELS OF LARGE WIDTH,
Imperial Coll. of Science and Techology, London (England).
For primary bibliographic entry see Field 02E.
W70-04553

A STOCHASTIC MODEL OF CONVECTIVE DIFFUSION FROM A CONTINUOUS SOURCE,
Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-04563

RELATION OF THE MANNING COEFFICIENT TO MEASURED BED ROUGHNESS IN STABLE NATURAL CHANNELS,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 02E.
W70-04565

MEASURED WAVE FORCE DATA ON OFFSHORE PLATFORMS,
Chevron Oil Field Research Co.
L. W. Thrasher, and P. M. Aagaard.
Journal of Petroleum Technology, p 339-346, March 1970. 8 p, 9 fig, 3 tab, 3 ref.

Descriptors: *Waves (Water), *Ocean waves, *Offshore platforms, *Hurricanes, *Energy, Hydrodynamics, Data collections, Hydraulics, Coastal engineering, Instrumentation.
Identifiers: Hurricane wave forces.

Wave forces on vertical cylinders and wave profiles were measured with instruments on two oil production platforms in 30 ft (1954-1958) and 100 ft (1960-1963) of water, respectively, in the Gulf of Mexico. Wave data were recorded during a number of storms and for waves up to 40 ft high. The purpose of the paper is to present the following background information that defines the wave force data being made available: (1) instrumentation, (2) raw data collected, (3) data processing steps, and (4) location of archives. (Knapp-USGS)
W70-04699

ANALYSIS OF WAVE FORCE DATA,
Shell Development Co., Houston, Tex.
D. J. Evans.
Journal of Petroleum Technology, p 347-358, March 1970. 12 p, 23 fig, 2 tab, 19 ref.

Descriptors: *Waves (Water), *Ocean waves, *Energy, Hurricanes, Hydrodynamics, Hydraulics, Offshore platforms, Coastal engineering.
Identifiers: Morison wave force equation, Stokes wave theory.

Wave profile and wave force data acquired in the Gulf of Mexico from several hurricanes have been analyzed to provide the drag and inertial coefficients of Morison's wave force equation. These coefficients are required to help determine design loads for offshore structures. An analysis, using nonlinear wave theories, of profile and force data from waves in shallow water gave drag and inertial force coefficients of 0.5 and 1.2, respectively. Data acquired in 100 ft of water gave a slightly larger drag coefficient (0.58) and a larger inertial coefficient (1.76). Good agreement between measured and predicted forces was observed. (Knapp-USGS)
W70-04700

METHOD FOR CALCULATING FORCES PRODUCED BY IRREGULAR WAVES,
Esso Production Research Co., Houston, Tex.
J. D. Wheeler.
Journal of Petroleum Technology, p 359-367, March 1970. 9 p, 11 fig, 4 tab, 14 ref.

Descriptors: *Ocean waves, *Energy, *Hurricanes, *Offshore platforms, Waves (Water), Hydraulics, Hydrodynamics, Coastal engineering, Mathematical studies.
Identifiers: Wave force, Airy theory, Morison wave force equation.

A new method is described and evaluated for calculating wave forces on offshore structures. It is based on an extension of Airy theory for two-dimensional waves and uses a linear filtering technique to calculate wave forces as a function of time for wave profiles of arbitrary shape and length. It is especially useful for evaluating the forces exerted on offshore structures by a sequence of irregular storm waves. The accuracy of the method is checked by comparison with measured hurricane-wave forces. (Knapp-USGS)
W70-04701

WAVE FORCES: DATA ANALYSIS AND ENGINEERING CALCULATION METHOD,
Florida Univ., Tallahassee; and Chevron Oil Field Research Co.
R. G. Dean, and P. M. Aagaard.
Journal of Petroleum Technology, p 368-375, March 1970. 8 p, 11 fig, 2 tab, 17 ref.

Descriptors: *Waves (Water), *Ocean waves, *Energy, *Offshore platforms, Hydrodynamics, Hydraulics, Coastal engineering, Computer programs, Mathematical models, Unsteady flow.
Identifiers: Morison wave force equation.

A mthod for calculating ocean wave forces on offshore drilling structures is based upon (1) data from two full-scale wave force measurement installations in the ocean and (2) a mathematical model representing hydrodynamic forces on submerged bodies in unsteady flow and the kinematic flow field of highly nonlinear waves. The method is applicable to a broad range of wave conditions commonly encountered in offshore structure design. Several comparisons show that the method represents measured forces satisfactorily for engineering design. (Knapp-USGS)
W70-04702

RADIATION TRANSFER AND INTERACTION OF CONVECTION WITH RADIATION HEAT TRANSFER,
Purdue Univ., Lafayette, Ind. School of Mechanical Engineering.
R. Viskanta.
Advances in Heat Transfer, Vol 3, p 175-251, Acad. Press, New York, London, 1966, 20 fig, 100 ref.

Descriptors: *Heat transfer, *Temperature, *Radiation, Microwaves, Conduction, Heating, Cooling, Thermal radiation, Laminar flow, Turbulent flow, Viscous flow, Fluid mechanics, Reynolds number, Boundary layers, Velocity, Momentum equations.

The purpose of the review is: (1) to develop general background information to analyze heat transfer in radiating media, and (2) to review the literature of some specific convection-radiation interaction problems. The radiation terms were included in the equations of continuity, motion, and energy, and an approximate solution was obtained for some flow patterns (Couette flow, laminar boundary layer flow, heat transfer to a radiating fluid flowing in a channel). The solution of the more complex equation is very time consuming even with the use of fast digital computers. (Novotny-Vanderbilt)
W70-05035

THE EFFECT OF FREE STREAM TURBULENCE ON HEAT TRANSFER RATES,
Brown Univ., Providence, R. I. Div. of Engineering.
J. Kestin.
Advances in Heat Transfer, Vol. 3, p. 1-32, Acad. Press, New York, London, 1966, 20 fig., 51 ref.

Descriptors: *Heat transfer, *Turbulence, Boundary layers, Turbulent boundary layers, Reynolds number, Heating, Cooling, Conduction, Convection, Heat flow, Temperature, Heat pollution, Flow around objects, Fluid mechanics.
Identifiers: Hydraulics of heat transfer.

The effect of free stream turbulence on the size of Nusselt's number, which characterizes heat flow, is discussed. Different methods of applying of the boundary layer theory are presented. The sound field which produces the harmonic oscillation can be used for studying of effects of oscillations on heat transfer instead of stochastic oscillations of the turbulence. An oscillating free stream velocity produces in a laminar boundary layer two main effects: (1) the velocity components u and v in the boundary layer themselves become time dependent, so that $u = u(x,y,t)$. (2) The oscillation inside of the boundary layer acquires a varying phase shift whose magnitude depends on the transverse coordinate y. Calculations showed that the skin friction coefficient on the plate boundary increases much less (by 5% for Pr approximately 0.7) than the Nusselt number (which increased by 26%) compared with the classical case of two-dimensional flow with zero vorticity in the approaching stream. It was found that the turbulence intensity expressed in % of (sq. root of u to the 12th power)/U has a small effect on the heat transfer coefficient in most cases. (Novotny-Vanderbilt)
W70-05036

HEAT AND MASS TRANSFER IN TURBULENT BOUNDARY LAYERS,
Akademiya Nauk SSSR, Novosibirsk.
A. I. Leonter.
Advances in Heat Transfer, Vol. 3, p. 33-100, Acad. Press, New York, London, 1966, 90 ref.

Descriptors: *Heat transfer, *Mass transfer, Boundary layer, Reynolds number, Films, Temperature, Turbulence, Convection, Conduction, Flow, Flow around objects, Heating, Cooling, Fluid mechanics.

The problem of heat exchange in flow with a high Reynolds number is discussed. Under these conditions, the relative thickness of the viscous sublayer tends to approach zero and the problem is reduced

to analyzing the influence of different disturbing factors as nonisothermality, mass transfer, longitudinal pressure gradient, etc. The theoretical base for the formulae developing was Prandtl's theory. It was found that in the compressible turbulent boundary layer on a flat impermeable plate, the effect of Reynolds number has little influence on the relative values of friction and heat transfer coefficients. The effect of a finite Reynolds number on the friction and heat transfer lows on a permeable plate is even smaller than that on impermeable plates. The mathematical presentation of theory developed in Russia is described. (Novotny-Vanderbilt)
W70-05037

ADVANCES IN FREE CONVECTION,
National Engineering Lab., East Kilbride (Scotland).
A. J. Ede.
Advances in Heat Transfer, Vol. 4, p. 1-64, Academic Press, New York, London, 1967, 111 ref.

Descriptors: *Convection, *Heat transfer, *Energy transfer, Turbulence, Turbulent boundary layer, Eddies, Reynolds number, Viscosity, Air circulation, Water circulation, Boundary processes, Conduction, Momentum transfer, Mixing, Cooling, Heating, Heat balance.
Identifiers: Theory of heat transfer.

Convection of heat in laminar and turbulent flow is discussed. Solution to the equations of continuity, motion and energy are used as a base for further theoretical development. The problem of cooling on a flat plate leads to the following general formula: Nu = f (Gr x Pr) to the 1/4 power, where Gr = Grashof number, Pr = Prandtl number and Nu = Nusselt number, all expressing the major heat flow parameters. Different solutions to this equation are discussed and comparison with experimental data are presented. Similar solutions were applied also to the solution of cooling (heating) in turbulent flow. It is generally assumed that the Grashof number or the Rayleigh number (Gr x Pr) serves as the criterion for stability in free heat convection and the Reynolds number for forced heat convection. Different solutions of the Nusselt number for turbulent flow expressing the flow of heat lead to the formula Nu = BGr (n), where the exponent n was found to be found to be 0.25 divided by 0.33 in most cases. (Novotny-Vanderbilt)
W70-05038

STATISTICAL MODELS FOR SURFACE RENEWAL IN HEAT AND MASS TRANSFER,
Argonne National Lab., Ill.
L. B. Koppel, R. D. Patel, and J. T. Holmes.
AIChE Journal, Vol. 5, No. 5, September 1966, p. 941-955, 3 tab., 7 fig., 4 ref. AEC Contract W-31-109-eng-8.

Descriptors: *Surfaces, *Mixing, Turbulence, Heat transfer, Mass transfer, Diffusion, Conduction, Heating, Cooling, Thermal properties, Thermal pollution, Thermal conductivity, Temperature, Hydraulics, Turbulent flow, Statistical models, Monte Carlo method.

In Part I, Average transport coefficients for different transport models are computed by using widely varying distributions of residence times of elements at the transporting surface. It is shown that, for typical transport models, the shapes of the residence time and age distributions have an insignificant effect on the average transport coefficient. Operational techniques for calculating average coefficients and for constructing delayed versions of age distributions are presented. Residence time distribution may be generated by the gamma form which offers the following advantages for representation of residence time distribution: (1) The residence times are defined over an interval from zero to infinity, (2) This distribution offers convenient operational properties for calculating the average transport coefficient. Computation of Nusselt numbers of heat transport in fluidized bed is presented. In Part II, methods are developed to estimate the mean residence time and the average transport coefficients of elements at a transporting surface from observations of only total elements counts, rather than from specific observations of individual elements. The accuracy of the methods is demonstrated in Monte Carlo simulated processes and experimentally at the wall of a gas-fluidized bed. (Novotny-Vanderbilt)
W70-05039

EXACT SIMILAR SOLUTION OF THE LAMINAR BOUNDARY-LAYER EQUATIONS,
Colorado Univ., Boulder.
C. F. Dewey, Jr., and J. E. Gross.
Advances in Heat Transfer, Vol. 4, p. 317-446, 1967. 14 fig.

Descriptors: *Boundary layer, Temperature, Convection, Mass transfer, *Heat transfer, Velocity, Reynolds number, Viscosity, Turbulence, *Laminar flow, Turbulent flow, Energy transfer, *Numerical analysis, Computers, Viscous flow.
Identifiers: Laminar boundary layer.

Comprehensive, systematic and accurate tables of solution to the laminar boundary-layer similarity equations were computed for a perfect homogeneous gas. Solutions are included to illustrate the effect of leading edge sweep, the mass transfer at the surface, pressure gradient, the boundary temperature, local external flow velocity, the Prandtl number, and the viscosity-temperature law of the fluid. The program for the numerical integration of the system of equations expressing the continuity, motion, and energy balance was written in FORTRAN for the IBM 7044. The system was treated as a two-point boundary value problem, and the Runge-Kutta method was employed for the numerical integration. (Novotny-Vanderbilt)
W70-05040

TURBULENT HEAT TRANSFER FROM SMOOTH AND ROUGH SURFACES,
Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.
R. A. Gowen, and J. W. Smith.
International Journal, Heat and Mass Transfer, Vol. 11, p 1657-1673, Pergamon Press, New York, London, 1968, 20 ref, 20 fig, 4 tab.

Descriptors: *Heat transfer, *Convection, Turbulence, Temperature, Momentum transfer, Turbulent flow, Thermal properties, Reynolds number, Air temperature, Water temperature, Velocity, Roughness.

Radial temperature profiles have been obtained in a 2-in I.D. rough tube of equivalent sand roughness equal to 0.05 for Prandtl numbers of 0.7, 5.9 and 14.3 over a Reynolds number range 10,000-50,000. Plots of t (+) against log y/R are linear as in the case of u (+) for rough and smooth tubes, but the slope depends on Prandtl number and inferentially on the roughness. The t (+) intercept at log y/R = 0 is strongly dependent on the Reynolds number, unlike u (+) in turbulent rough pipe flow. An expression for the relation between t (+) and log y/R is presented, but the dependence of the slope AR on roughness remains to be determined. The heat-transfer efficiency St/CF was less in rough tubes than smooth ones for all the fluids studied, but the relative difference becomes smaller at higher Prandtl number and in the turbulent transition region. Friction factors and heat-transfer coefficients have also been measured in seven different 1/2-in I.D. rough pipes of known surface geometry. Equivalent sand roughness ranged from 0.021 to .095 for the pipes studied. A semi-theoretical equation based on the temperature profiles obtained in the 2-in. pipe predicts the results of the present study and Nunner's air results adequately. It underestimates the water results of Dipprey. (Novotny-Vanderbilt)
W70-05041

FLOW AND HEAT TRANSFER IN THE BOUNDARY LAYER ON A CONTINUOUS MOVING SURFACE,
Minnesota Univ., Minneapolis. Heat Transfer Lab.
F. K. Tsou, E. M. Sparrow, and R. J. Goldstein.
International Journal Heat and Mass Transfer, Vol. 10, p. 219-235, 1967. 11 ref., 11 fig.

Descriptors: *Heat transfer, Boundary processes, Mass transfer, Turbulent flow, Laminar flow, Mixing, Reynolds number, Turbulent boundary layers, Viscosity, Energy transfer, Momentum transfer, Convection, Velocity, Friction, Viscous flow.
Identifiers: Laminar boundary layers.

A combined analytical and experimental study of the flow and temperature fields in the boundary layer on a continuous moving surface has been carried out. The investigation includes both laminar and turbulent flow conditions. The analytical solutions provide results for the boundary-layer velocity and temperature distributions and for the surface-friction and heat-transfer coefficients. Measurements of the laminar velocity field are in excellent agreement with the analytical predictions., thereby verifying that a mathematically describable boundary layer on a continuous moving surface is a physically realizable flow. Experimentally determined turbulent velocity profiles are also in very good accord with those of analysis. Similar agreement is found to exist for friction coefficients deduced from the data by application of the Clauser-plot technique. Temperature distribution measurements, carried out for the turbulent boundary layer, show satisfactory correspondence with analysis. (Novotny-Vanderbilt)
W70-05042

HEAT TRANSFER-A REVIEW OF CURRENT LITERATURE,
Minnesota Univ., Minneapolis. Heat Transfer Lab.
E. R. G. Eckert, W. E. Ibele, and R. J. Goldstein.
Int. Journal Heat and Mass Transfer, Vol. 11, p. 83-116, 1968. 591 ref.

Descriptors: *Heat transfer, *Energy transfer, *Mass transfer, Conduction, Convection, Boundary layers, Cooling, Heating, Heat balance, Diffusion, Radiation, Thermal pollution, Thermal radiation, Laminar flow, Turbulent flow, *Reviews.
Identifiers: Literature review.

The review is concerned with research in the field of heat transfer, the results of which have been published during 1966 or late in 1965. The review contains the papers published in the following areas of the research of heat transfer: conduction of heat, channel flow, boundary layer flow, flow with separated regions, transfer mechanisms, natural convection, convection with rotating surfaces, combined heat and mass transfer, change of phase, radiation, liquid metals, low-density heat transfer, non-Newtonian fluids, measurement techniques, heat exchangers, aircraft and space vehicles, thermodynamic and transport properties. (Novotny-Vanderbilt)
W70-05043

8C. Hydraulic Machinery

SONIC POLE TESTS PROVE RELIABLE AND INEXPENSIVE,
Detroit Edison Co., Mich.
R. B. Freydl, and B. D. Miller.
Transm Distrib, Vol 21, No 11, p 37-41, Nov, 1969. 5 p, 7 fig, 2 tab, 2 ref.

Descriptors: Costs, Instrumentation, X-ray inspection, Field tests, Laboratory tests, *Ultrasonics, Electronic equipment, Defects, *Sound waves, Wood, Inspection, Transmission lines, Power operation and maintenance.
Identifiers: *Sonic-pulse test, Sonic probes, *Wood-pole transm lines, Cost savings, Ultrasonic tests, Test results.

A sonic test instrument developed for determining defects in wood poles is fast, reliable, and economical. Results of the testing technique on nearly 300,000 poles during the past 3 yr have been successful and the per-pole cost of inspection has been reduced substantially. The sonic testing device is a 5-lb, portable, transistorized meter that evaluates the time required for a sound pulse to travel from one side of a pole to the other. Longer than normal travel time indicates decay or defect. The probes normally can be pushed through the earth against the pole without digging to test below the ground surface. Only poles showing defects must be checked by the X-ray method. The sonic test is fail-safe, showing pole characteristics other than pole life or strength. (USBR)
W70-04622

EXCITATION CONTROL FOR SYSTEM DAMPING TESTS ON MODEL SYSTEM,
Bureau of Reclamation, Denver, Colo.
F. R. Schleif.
Bur Reclam Lab Rep EP-32, Aug, 1969. 41 p, 10 fig, 3 tab, 20 oscillograms, 4 ref.

Descriptors: *Electric power, Model studies, *Control systems, Faults (Electrical), Voltage regulators, Governors, *Stabilization, *Damping, Transmission (Electrical), Electric generators, *Excitation, Model tests.
Identifiers: Electrical system simulators, *Excitation regulators, Power system stability.

Performance tests of supplementary excitation control apparatus for system damping, conducted on the Edison Electric Institute model system in cooperation with the AC/DC System Operation Research Project, have been very revealing. Flexibility of the model permitted evaluation under a range of conditions not conveniently obtainable on one power system. Evaluations included: (1) influence of local resistive and induction motor loads, (2) performance during system faults, (3) signal cutoff vs signal limit-type constraints, and (4) performance on a-c and on a-c and d-c transmission systems with and without modulation of the latter for damping. Effectiveness and compatibility were good. The mechanism of damping, characteristics, and applicability are discussed. (USBR)
W70-04623

DIELECTRIC STRENGTH OF OIL-IMPREGNATED INSULATION UNDER HVDC STRESSES,
Brown, Boveri and Co. Ltd., Baden (Switzerland).
G. Maier, and H. J. Vorwerk.
Brown Boveri Rev, Vol 56, No 5, p. 246-255, May 1969. 10 p, 14 fig, 1 tab, 5 ref.

Descriptors: *Dielectrics, *Electric insulation, *Direct current, Transformer oils, Impulse tests (Electrical), Electric potential, Power transformers, Electric reactors, Converters (Electrical), Transmission lines, Foreign research, Electrical equipment, Electrical insulators, Stress, Alternating current, Polarity.
Identifiers: *Electrical insulation tests, *High voltage, Dielectric properties, Test results, Withstand level (Electric), Switzerland.

Converter transformers, smoothing reactors, and auxiliary power apparatus used in hvdc transmission systems have insulation similar to that in a-c voltage equipment. The primary insulating materials are oil, oil-impregnated paper, transformer board, and in certain cases bakelized synthetic resin-bonded paper. The materials in hvdc systems are under different stresses than materials in a-c applications. In one instance, the dielectric voltage distribution obeys different laws, and in the other, the breakdown phenomena and dielectric properties are different compared to the a-c voltage conditions. These particular features must be taken into consideration when designing hvdc systems, assuming that new problems are known and that adequate experience has been gained regarding the behavior of the insulating materials under given conditions. Simple models were used to perform tests on the main insulating materials including oil, oil-impregnated paper, and transformer board using specific voltages similar to those occurring in the converter transformers and smoothing reactors in hvdc stations. Various guides were derived from the measured results, indicating the aptness of some voltage tests on finished equipment. (USBR)
W70-04640

DIELECTRIC STRENGTH RECOVERY CHARACTERISTICS AFTER FAULT ARC EXTINCTION IN 500-KV TRANSMISSION LINES,
Chubu Electric Power CO. (Japan).
H. Terase, K. Sadamoto, and K. Abe.
Elec Eng Japan, Vol 89, No 2, p. 29-38, 1969. 10 p, 8 fig, 1 tab, 5 ref.

Descriptors: *Dielectrics, *Faults (Electrical), *Transmission lines, *Electrical insulators, Electric currents, Extra high voltage, Electric insulation, Experimental data, Electric arcs, Electric potential, Recovery, Photographs, Foreigh research, Characteristics, Electrodes, Time.
Identifiers: *Dielectric properties, Ionization potentials, Japan, *Suspension insulators, Photographic analysis, Test results.

The study of dielectric strength recovery characteristics after fault arc extinction is important in determining the no-voltage time of a high-speed, 3-phase, reclosing system. Few papers have discussed the problem, and few experimental studies have been reported. Large fault current interruption is discussed. The dielectric strength recovery characteristics of suspension insulators and V- and dead-end strings in 500-kv transmission lines were studied by applying a probing voltage of slow wavefront to the insulators at about 5 cycles after the interruption of a fault arc current of 8 ka. Results from the high-speed camera photograph show that the behavior of a luminous gas cloud emerging from arcing horns is related closely to the recovery characteristics. (USBR)
W70-04642

DISCHARGE MEASUREMENTS USING THE RADIOISOTOPE VELOCITY, INTEGRATED SAMPLE, DILUTION, AND TOTAL COUNT METHODS AT FLATIRON POWER AND PUMPINS PLANT, COLORADO-BIG THOMPSON PROJECT,
Bureau of Reclamation, Denver, Colo.
J. C. Shuster, and R. L. Hansen.
TID-25185, U S Atom Energy Comm, Contract AT (49-11)-2758, July 1969. 41 p, 28 fig, 15 tab, 1 ref, addend.

Descriptors: *Water measurements, *Radioisotopes, *Tracers, *Discharge measurements, Hydraulics, Physics, Fluorometry, Penstocks, Field tests, Pump turbines, Water sampling, Turbines, Injectors, Pipelines, Radioactivity techniques, Colorado.
Identifiers: *Velocity method, *Total count method, *Dilution method, Flatiron Powerplant, Colo, Atomic Energy Commission.

Radioisotopes techniques and equipment are being developed to improve methods for measuring flow rate in high-head turbines and pumps. A series of discharge measurements was made in 1968, at Flatiron Power and Pumping Plant near Loveland, Colo, to evaluate techniques and equipment. Measurements were made on a 6000-ft-long, 6-ft-dia penstock at a discharge of 300 cfs. Thirty-seven injections of radioactive Bromine-82 were made for discharge measurements by the velocity method, 17 for the integrated-sample method, and 8 for the dilution method. The injections enabled computation of 33 discharges by the velocity method, 26 by the integrated sample method, 45 by the dilution method, and 34 by the total-count method. A 4-point injection system, 45 deg from the vertical and horizontal centerlines of the pipe, was used for most measurements. Mixing lengths ranged from 36 to 919 pipe diameters. Mixing lengths of 100 pipe diameters produced the same order the accuracy as mixing lengths of 919 diameters. Studies are continuing to increase measurement accuracy using pipe lengths as short as 30 pipe diameters. (USBR)
W70-04645

30 YEARS OF MAINTENANCE EXPERIENCE WITH LARGE KAPLAN TURBINES,
Corps of Engineers, Bonneville, Oreg
Edward E. Ashley.
Amer Soc Mech Eng Publ, 69-WA/FE-17, Nov 1969. 8 p, 16 fig, 1 tab.

Descriptors: *Kaplan turbines, *Maintenance, Failure (Mechanics), Turbine parts, Thrust bearings, Hydroelectric plants, Turbine blades, *Bonneville Dam, Power operation and maintenance, Corrosion, Lubrication, Repairing, Contamination, Turbines, Costs.
Identifiers: Wicket gates, Packings.

Major problems encountered during 30 yr of operating large Kaplan turbines at the Bonneville Project are described. A few problems have been solved; others are being reviewed. The problem area includes theturbine and equipment associated with the turbine. Problems have involved: (1) grease line failure to the wicket gate lower bearing, failure of the wicket gate combination thrust and guide bearing, failure of the wicket gate stop block, and failure of a turbine guide bearing; (2) replacement of head cover sump pumps; and (3) maintenance of the turbine shaft packing box, turbine hub, wicket gate servomotor packing, Kaplan turbine blades, and oil head. Each problem is discussed and methods used in solving the difficulty are given. (USBR)
W70-04646

DESALINATION PLANTS USING HIGHER STEAM PRESSURES,
Catalytic Construction Co., Philadelphia, Pa.
W. Pechenick, and C. E. Ennis.
Preprint SM-113/31 of Paper Presented at IAEA Symp. Nucl. Desalination, Madrid, Spain, Nov. 18-22, 1968. 8 p, 8 ref.
Identifiers: *Dual-purpose plant economics, Dual-purpose plant, Multiple effect distillation, Multistage flash distillation, Scale prevention, Single-purpose plant, Single-purpose plant economics, Steam cycle, Turbines, Vapor compression evaporation.

Distillation plants may use high pressure steam (above 150 psig) in one of two ways - as a source of mechanical energy in vapor compression or as a source of thermal energy directly in high temperature plants. High temperature operation has been made possible by development of the Mems plant and by development of improved scale control processes making 350 deg F operation feasible. Increasing the pressure range over which plants can utilize steam broadens the economic scope of desalting. Single-purpose plants, typified by a VC design can prove economical over a broader range of capacities and cost parameters. Dual-purpose plants may now be designed over a greater range of water-to-power ratios than was possible at lower pressures.
W70-04670

RESEARCH AND DEVELOPMENT ON THE HORIZONTAL SPRAY FILM EVAPORATOR.
Aqua-Chem, Inc., Waukesha, Wis.
For primary bibliographic entry see Field 03A.
W70-04671

LARGE COMBINED AXIAL- AND MIXED-FLOW PUMP,
Bureau of Reclamation, Denver, Colo.
Ernest H. Johnson.
Pap 69-WA/FE-31, Amer Soc Mech Eng Publ, 1969. 8 p, 9 fig, 1 tab.

Descriptors: *Axial flow, *Propeller pumps, *Mixed flow pumps, *Pumps, Mechanical equipment, *Models, *Model tests, Design, Cavitation, Pump bowls, Vibrations, Efficiencies, *Hydraulic design, Instrumentation, Discharges, Specifications, Pump testing, Performance tests.
Identifiers: *Snake Creek Pumping Plant (N Dak), *Test results, High head, Garrison Diversion Unit (MRBP), Low head.

The large 685-cfs, 200-rpm, vertical-column main pumps to be installed by the Bureau of Reclamation at Snake Creek Pumping Plant No. 1, Garrison Diversion Unit, Missouri River Basin Project, N Dak, are described. Each pump has interchangeable axial- and mixed-flow bowl assemblies covering a head range of 2 to 76 ft. This arrangement combines 2 types of pumps into one. The wide head range resulted in a selection of 2 to 35 ft for the low-head, axial-flow bowl assembly, and 35 to 76 ft for the high-head bowl assembly. The time between bowl assembly interchange will depend upon runoff and reservoir storage conditions and will occur at intervals varying from 2 to 9 yr. The interchange operation will require about 2 days per pump. Model tests indicate an excellent design meeting or exceeding all requirements of the specifications. Model operation was smooth and quiet without apparent cavitation throughout the normal operating head range of each bowl assembly; no excessive vibration occurred from minimum to shutoff head. (USBR)
W70-04894

8D. Soil Mechanics

AIRPHOTO INTERPRETATION OF FLOOD PLAIN SOILS,
Wisconsin Univ., Madison.
Ralph W. Kiefer.
Proc Amer Soc Civ Eng, J Surv Mapp Div, Vol 95, No SU1, p 49-70, Oct 1969. 22 p, 16 fig, 32 ref, append.

Descriptors: *Aerial photography, *Photogrammetry, *Flood plains, *Soil surveys, Soil formation, Flood plain zoning, Land use, Mapping, Remote sensing, Soils, Soil types, Terrain analysis, Planning, Photography, Project planning, Radar, Soil classifications, Soil investigations, Soil texture, *Soil surveys, Bibliographies, Geological surveys, Sensors.
Identifiers: *Aerial interpretation, *Photointerpretation, *Airborne surveying, *Flood plain studies, Soil deposits, Airborne equipment.

Urban planners and developers are giving increasing emphasis to the problems of land use on flood plains. To plan effectively for land use on flood plains, the distribution of soil types on the flood plain and the flood frequency must be known. The use of aerial photographic interpretation techniques for estimating flood plain soil conditions is described. New techniques of airborne remote sensing can also prove useful in flood plain soil studies. Imaging sensors such as infrared photography, color photography, infrared imagery, and side-looking airborne radar, as well as several nonimaging sensors, are described. To plan successfully for land use on flood plains, all available planning tools must be utilized. Much valuable information about flood plain soils can be obtained through aerial photographic interpretation studies. (USBR)
W70-04630

THE PHYSICS AND MECHANICS OF SOIL,
California Inst. of Tech., Pasadena.
Ronald F. Scott.
Contemp Phys, Vol 10, No 5, p 449-472, Sept 1969. 24 p, 18 fig, 8 ref.

Descriptors: *Soil formation, *Soil physics, *Soil mechanics, Soil analysis, Soil classifications, Soil compaction, Soil engineering, Soil groups, Soils, Soil properties, Flexible foundations, Earthworks, Reviews, Soil tests.
Identifiers: Soil characteristics, Soil development, Lunar soils.

The processes of soil formation, present knowledge of soil behavior, and techniques of soil engineering are reviewed. The origin of soil is in chemical processes of comminution and abrasion of rock masses and in physical processes of solution and recrystallization of rock minerals. After formation, soil is transported and distributed by a variety of agencies before subaerial or subaqueous deposition. Most soils experience several cycles of sedimentation, uplift, erosion, and redeposition. Mechanical behavior of soils under the stresses imposed by engineering structures varies with the type of soil. Deformation and failure of soils are of interest in designing structures, and must be studied by special laboratory tests. Solving soil engineering problems involves a field investigation and sampling program to define the boundaries of the soil involved, laboratory testing of the soil, and analytical or computer calculations to determine the displacements and stresses that will occur in the soil and structure. Problems of particular interest include: slope failures; design of earth dams, retaining walls, and piled structures; displacement and failure of soil under buildings, and determination of soil properties on the surface of the moon and other planets. (USBR)
W70-04631

EFFECTS OF REMOLDING ON THE PROPERTIES OF A LATERITIC SOIL,
Oklahoma State Univ., Stillwater.
Frank C. Townsend, Phillip G. Manke, and James V. Parcher.
Highw Res Rec, No 284, p 76-84, 1969. 9 p, 2 fig, 3 tab, 17 ref.

Descriptors: *Laterites, *Residual soils, *Soil properties, Mechanical properties, Lime soil mixtures, Soils, Soil asphalt, Soil cement, Soil groups, Soil engineering, Soil formation, Soil strength, Soil mechanics, Soil tests, Soil physical properties, Soil stabilization, Soil structure, Bibliographies, Soil types, Test procedures.
Identifiers: Panama, Soil characteristics, Soil deposits, Soil development, Soil recompaction.

Engineering characteristics of a Panamanian lateritic soil were studied and the suitability of various stabilizing additives was investigated. Remolding by mechanical agents altered the physical properties and strength parameters of the soil. Grain size analysis and Atterberg limits tests show that remolding causes a breakdown of the granular structure and an increase in the plasticity of the soil. The efficacy of various stabilizing additives using worked and unworked soil samples was investigated. Stabilization is influenced by the amount of mechanical working. Portland cement was the most effective of the 3 additives tested and yielded higher unconfined compressive strengths with the unworked soil. Lime was also an effective stabilizer, but reacted more favorably with the soil in the worked condition. The primary benefit derived from asphaltic stabilization was waterproofing rather than substantial strength gains. A substantial portion of the clay particles was coated with iron and aluminum oxide (sesquioxide) films, and working by mechanical agents caused a breakdown of this coating allowing the clay particles to behave in a more characteristic fashion. (USBR)
W70-04632

A DROP HAMMER PENETROMETER FOR DETERMINING THE DENSITY OF SOILS AND GRANULAR MATERIALS,
Clemson Univ., S.C.
Joseph P. Rostron, Arnold E. Schwartz, and Thomas E. Gioliosa.
Highw Res Rec, No 284, p 70-75, 1969. 6 O, 5 fig, 2 tab, 7 ref.

Descriptors: *Penetrometers, *Soil density, *Soil tests, Penetration resistance, Penetration tests, Soil moisture, Soil engineering, Soil mechanics, Soil properties, Calibrations, Compacted soils, Soil physical properties, Field tests, Fine-textured soils, Granular materials, Test procedures, Moisture content.
Identifiers: *Testing equipment, Accuracy, Construction control, Correlation.

The possible application of a drop hammer penetrometer to determine the density of soils was investigated. The penetrometer was designed to use a measured number of blows for a certain depth of penetration along with the use of a surcharge. For a given moisture content, a straight-line relationship was found between dry density and penetration resistance for the fine and granular materials tested. For field application of the drop hammer penetrometer, each soil must be calibrated for moisture sensitivity and penetration resistance characteristics. Because of possible thixotropic behavior, time lag between compaction and penetration readings should be kept to a minimum. The overall standard error of the procedure for all materials tested was 2.2 pcf. Total time required to determine the density of a calibrated soil using the penetrometer and the speedy moisture tester was approximately 15 min. (USBR)
W70-04633

PRESSUREMETER CORRELATION STUDY,
Louisiana Dept. of Highways, Baton Rouge.
C. M. Higgins.
Highw Res Rec, No 284, p. 51-62, 1969. 12 p, 10 fig, 19 ref.

Descriptors: *Shear strength, *Soil tests, *Cohesive soils, Shear tests, Soil compression tests, Soil engineering, Soil mechanics, Soil properties, Soil strength, Unconfined compression, Test procedures, Apparatus, Bibliographies.
Identifiers: *Menard pressuremeter, *Comparative studies, Pressure probes, Correlation, In situ tests, Testing equipment.

Shear strengths of cohesive soils obtained in place in boreholes using the Menard pressuremeter system are compared to strengths obtained by unconfined compression tests and by consolidated undrained triaxial tests. Correlation was good for soft, fairly uniform soils, but the pressuremeter showed consistently higher strengths in soils interspersed with materials different from the majority of the material and in soils with other types of discontinuity. The pressuremeter yields a strength prediction between that of the majority of the material and that of the weaker areas in the sample. Conventional test strengths probably are those of the weakest areas in the cores. Advantages of the pressuremeter are: (1) portability; (2) performs the test in place, causing less disturbance to the tested material; and (3) faster and somewhat more economical use. Disadvantages are: (1) extreme sensitivity to hole size, (2) sharp aggregates within the sample may burst the probe, and (3) special methods probably will be required for noncohesive soils. Pressuremeter-derived strengths are closer to the average confined in-place strength of the soils than those obtained by conventional methods. (USBR)
W70-04634

DEVELOPMENT OF A HIGH-VELOCITY IMPACT TEST FOR LABORATORY COMPACTION OF GRANULAR MATERIALS,
Indiana State Highway Commission.
R. P. Dove, T. G. Williamson, and H. R. J. Walsh.
Highw Res Rec, No 284, p 37-50, 1969. 14 p, 9 fig, 1 tab, 7 ref.

Descriptors: *Compaction tests, *Laboratory tests, *Granular materials, *Impact tests, Laboratory equipment, Test procedures, Cohesionless soils, Soil tests, Soil density, Soil compaction, Soil engineering, Soil mechanics, Moisture content, Construction materials, Apparatus, Materials testing, Optimum moisture content.
Identifiers: *Testing equipment, *Construction control, Comparative studies, Vibratory compaction, Equipment design, Correlation.

Development of apparatus and procedures for a laboratory compaction test aimed at simulating field compaction of granular materials is described. The technique includes: (1) use of larger molds (6 in. dia by 9 in. high) and utilization of all sizes of aggregate (up to 1-1/2 in.) commonly used in Indiana for base and subbase materials; (2) compaction in one layer (similar to a field lift) approximately 9 in. in original thickness and 6 in. when compacted; (3) a head plate that covers the entire sample surface; and (4) compaction by impacts from a vibratory shaker and by standard drop hammers. Moisture-density curves obtained on Indiana granular base and subbase materials are compared to curves from Standard and Modified AASHO methods, and certain problems of technique are discussed. Relatively steep compaction curves are obtained using the method and maximum density values can be determined accurately. (USBR)
W70-04635

GEOLOGICAL INFLUENCES ON THE STABILITY OF CLAY SHALE SLOPES,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
E. L. Krinitzsky, and Charles R. Kolb.
Proc 7th Annu Eng Geol Soils Eng Symp, p 160-175, Moscow, Idaho, Apr 1969. 16 p, 9 fig, 16 ref.

Descriptors: *Engineering, *Slope stability, *Clay shales, Geology, Effects, Stability, Soil mechanics, Structural relaxation, Slopes, Precipitation (Atmospheric), Bibliographies, Weathering, Groundwater, Landslides, Erosion, Shales, Topography, Mineralogy, Structure.
Identifiers: Geologic defects, Sliding resistance, Rock slope.

Influences of lithology, erosion, structural relaxation, weathering, local topography, precipitation and ground water, rock structure, and rock fabric on the stability of clay shale slopes are discussed. Stability is determined by combinations of these factors; the importance of each can vary over short distances. Major influences are the various aspects of lithology, structure, and ground water. Several examples of landslides are cited. (USBR)
W70-04644

8F. Concrete

RECOMMENDATIONS FOR TESTING CONCRETE BY THE ULTRASONIC PULSE METHOD,
R. Jones, and I. Facaoaru.
Mater Struct, Vol 2, No 10, p 275-284, July-Aug, 1969. 10 p, 5 fig, 5 tab.

Descriptors: Concrete construction, Concrete control, Concretes, Wave velocity, Concrete structures, Concrete technology, *Concrete testing, *Ultrasonics, Elasticity modules, Elasticity (Mechanical), Poisson ratio, Compressive strength, Instrumentation, Measuring instruments.
Identifiers: *Concrete properties, Foreign testing, Great Britain, *Ultrasonic impulse method, Soniscopes, *Pulse velocity tests.

Recommendations are given for application of the ultrasonic pulse method to determine elastic properties, strength, homogeneity, location of internal defects, and changes in concrete properties. Methods of measuring pulse velocity and influence of test conditions on accuracy are discussed. The recommended procedures should lead to better standardization of measuring techniques. Interpretation difficulties arise in deriving elastic properties and strength from in situ measurements of pulse velocity, but may be overcome by following the recommended methods. (USBR)
W70-04620

RECOMMENDATIONS FOR THE USE OF RESONANCE METHODS FOR TESTING CONCRETE,
Institute for Building Technics, Warsaw (Poland).
L. Brunarski.
Mater Struct, Vol 2, No 10, p 269-273, July-Aug, 1969. 5 p, 6 tab.

Descriptors: Vibrations, *Non-destructive tests, Instrumentation, Test procedures, Test specimens, Testing, Transverse waves, Longitudinal waves, Elasticity (Mechanical), *Elasticity modulus, *Concrete testing, Concretes, Concrete technology, *Natural frequency, Materials testing.
Identifiers: *Resonance frequency method, Foreign testing, *Torsional resonant frequency, *Rigidity modulus.

Recommendations on resonance frequency methods for testing concrete, accepted at the RILEM Working Group Meeting on Nondestructive Testing of Concrete held at Varna, Bulgaria, in Sept 1968, are presented. The recommendations were developed by members of Working Groups from Czechoslovakia, Japan, Poland, Soviet Union, United Kingdom, and United States. Specific recommendations are given for: apparatus characteristics; shape, dimensions, curing conditions, and age of test specimens; specimen support and positioning of driver and pickup for longitudinal, flexural, and torsional modes of vibration; formulas for calculating dynamic elasticity moduli; and symbols and units in SI and MKfs systems. (USBR)
W70-04621

ABNORMAL SET OF PORTLAND CEMENT - CAUSES AND CORRECTIVES,
Bureau of Reclamation, Denver, Colo.
G. L. Kalousek.
Bur Reclam General Rep 45, REC-OCE-69-2, Nov 1969. 23 p, 8 fig, 5 tab, append.

Descriptors: *Portland cements, *Concrete technology, *Gypsum, *Concrete additives, *Crystallization, *False set, Hydrates, Differential thermal analysis, Cements, Thixotropy, Hardening, Setting (Materials).
Identifiers: Ettringite, Cement hydration, Cement chemistry, Glossaries.

Abnormal set of portland cement may be due to different combinations of several causes. Gypsum recrystallization was confirmed as one cause. The rate of ettringite precipitation of certain cements treated with organic admixtures correlated with the rate of stiffening of the mortars. Thixotropic set was determinable on cement-benzene slurries with a thixometer, an instrument developed for the purpose. Thixotropic behavior was induced by aeration at 50% R H and persisted in cement-water pastes from about 10 sec to over 11 min. The rate of gypsum and ettringite formation was followed by differential thermal analysis. The causes of and correctives for abnormal set are described. (USBR)
W70-04627

CONCRETE PERFORMANCE IN YELLOWTAIL DAM, MONTANT--5-YEAR CORE REPORT,
Bureau of Reclamation, Denver, Colo.
J. R. Graham.
Bur Reclam Rep C-1321, Oct 1969. 40 p, 20 fig, 14 tab, 2 ref, append.

Descriptors: *Concrete testing, *Mass concrete, Concretes, Compressive strength, Poisson ratio, Concrete control, Elasticity modulus, Concrete dams, Laboratory tests, Concrete technology, Cores, Construction joints, Concrete mixes, Aging (Physical), Physical properties.
Identifiers: Concrete properties, Yellowtail Dam (Mont), Longtime tests.

Laboratory physical properties tests were performed on 10-in.-dia cores drilled from mass concrete in Yellowtail Dam, Mont. Strength and elastic properties were determined on the concrete specimens at 6-mo, 1-, and 5-yr ages. Results indicate a well-designed, properly consolidated, good-quality concrete. The study is part of a series in the Bureau of Reclamation's 20-yr evaluation of strength and elastic properties, of concrete in various dams. Some findings based on tests of the cores are: (1) strength development continued to 5-yr age; (2) vertically drilled cores exhibited higher compressive strengths than cores drilled horizontally; (3) modulus of elasticity increased somewhat to 5-yr age; and (4) wet-sandblast-prepared construction joints are better than those prepared by water jetting. Cement efficiencies, coefficient of variation of strengths, and other properties are discussed. (USBR)
W70-04628

PRECAST CONCRETE UNITS USED AS FORMS FOR CAST-IN-PLACE CONCRETE,
American Concrete Inst., Detroit, Mich.
William R. Waugh, Martin W. Boll, and George F. Bowden.
Amer Concr Inst J Proc, Vol 66, No 10, p 798-813, Oct 1969. 16 p, 12 fig, 32 ref.

Descriptors: *Concrete construction, *Precast concrete, *Formwork (Construction), Architecture, Concretes, Bonding, Bridges, Mass concrete, Buildings, Concrete technology, Floors, Bibliographies, Concrete dams, Hydraulic structures, Joints (Connections), Reinforced concrete, Roofs, Structural design, Prestressed concrete, Walls.
Identifiers: Bond, Concrete blocks.

Precast concrete units, unreinforced, reinforced, or prestressed, are used as forms for cast-in-place and precast concrete. Precast units as forms for cast-in-place and precast concrete. Precast units as forms for cast-in-place work are discussed, showing how such units are used: (1) as structurally adequate for applied loads and concrete pressures without support except ties and alinement braces, or (2) as liners for forms made of other materials. The concrete forms may be removed after casting or remain in place as a permanent part of the structure. A principal application of stay-in-place forms has been as architectural facing, but some become structurally composite with the cast-in-place concrete. Development of various types of precast forms including ferrocement and facing slabs for mass concrete and hydraulic structures is surveyed, but the main concentration is on structural and architectural uses most prevalent in the U.S. and Canada. Typical formwork installations are described, and factors influencing use are discussed. Design and construction requirements for this type of formwork are outlined and suggestions for handling, erection, and use of precast forms are made. Recommendations are given for treatment of joint and connection details and for bond and anchorage of the form units. (USBR)
W70-04629

LARGE AGGREGATE SHOTCRETE CHALLENGES STEEL RIBS AS A TUNNEL SUPPORT,
Bechtel Corp., San Francisco, Calif.
Harry Sutcliffe, and Cole R. McClure.
Civ Eng, Vol 39, No 11, p. 51-55, Nov 1969. 5 p, 3 fig, 3 photo.

Descriptors: *Tunnel linings, *Gunite, *Pumped concrete, *Tunnel construction, Construction, Tunneling, Creep, Aggregates, Compressed air, Accelerators, Reinforcing, Underground structures, Axial loads, Durability.
Identifiers: *Tunnel supports, *Sprayed concrete, *Concrete linings, Compressive stress.

A growing need for underground construction exists in transportation, pumped storage, pollution control, and defense works. The rate of growth of tunnel construction is limited only by the higher cost when compared with above-ground construction. A substantial portion of the cost of underground work is in the support and lining of the excavation, and making this area more economical is important. Any acceleration of the rate that support or lining can be placed permits the use of faster tunneling machines and reduces costs. Gunite, a pneumatically applied cement mortar used in canal linings, has been used with wire-mesh reinforcement in tunnels to prevent slaking and spalling

of the ground, with good durability and resistance to abuse. The spraying of large-aggregate concrete was only mildly successful until European research with chemical accelerators provided a means of controlling the rate of strength buildup of the sprayed material. Use of accelerators started the changes in application practices and furthered the acceptance of shotcrete in underground work. First used in combination with steel ribs and wire mesh shotcrete is used more frequently unreinforced. (USBR)
W70-04636

8G. Materials

COMPARISON OF CHEMICALLY AND ELECTROLYTICALLY INDUCED PITTING CORROSION,
General Motors Corp., Warren, Mich. Dept. of Chemistry; and Connecticut Univ., Storrs. Corrosion Research Lab.
W. D. France, Jr., and N. D. Greene.
Corrosion, Vol 26, No 1, p 1-4, January 1970. 4 p, 5 fig, 1 tab, 19 ref. OSW Grant No 14-01-0001-458.

Descriptors: *Pitting (Corrosion), *Corrosion, *Brines, *Desalination apparatus, *Stainless steel, Saline water, Saline water systems, Water chemistry, Chemical reactions, Electrolysis, Metallurgy, Corrosion control.
Identifiers: Zirconium.

Studies of pitting of zirconium and stainless steel in acidic and near-neutral chloride media show that controlled potential and conventional chemical corrosion tests do not yield similar rates or types of attack under identical environmental conditions. Such discrepancies limit critical pitting potential measurements and related techniques for evaluating and comparing pitting in halide environments like those in desalination equipment. A theoretical explanation based on the accumulation of chloride at anodically polarized electrode surfaces is presented. (Knapp-USGS)
W70-04550

THE APPLICATION OF A DIGITAL COMPUTER TO MECHANICAL TESTING,
Union Carbide Corp., Oak Ridge, Tenn.
James H. Smith.
Exp Mech, Vol 9, No 11, p 23N-28N, Nov, 1969. 6 p, 12 fig.

Descriptors: *Digital computers, Computer programming, Computers, Data processing, Data reduction, Experimental data, *Materials testing, Mechanical properties, *Metals testing, Laboratory tests, Testing, Testing machines, Stress-strain curves, Computation.
Identifiers: Analog-to-digital converter, Display systems, *Testing equipment, Test results, Strain energy, Computer printouts.

A digital computer may be programmed to record raw data and to provide automatic data calculations for mechanical tests. An evaluation is given of a computer system connected to a universal testing machine and a torsion tester. The computer is connected to the testing machines by an analog-digital converter. The system records raw load-strain data, converts to stress-strain data, and calculates any mechanical properties desired from the test. The computer also can provide a printout and a paper tape of the data. An oscilloscope display is obtained as data are recorded. Tensile, compression, pin bearing, double shear, and torsion tests are being performed. Data being recorded include ultimate strength, offset yield strength, elastic and shear moduli, energy under the stress-strain curve, and a mathematical expression for the stress-strain curve. In addition to the mechanical load-strain curve provided by the test machine, the computer can provide a stress-strain curve and a listing of stress-strain data points. (USBR)
W70-04624

MEASURING MOISTURE WITH GAMMA RADIATION,
F. E. McKinney.
Isotop Radiat Technol, Vol 7, No 1, p. 29-35, Fall 1969. 7 p, 7 fig, 2 tab, 23 ref.

Descriptors: *Gamma rays, *Moisture content, *Moisture meters, *Nuclear moisture, *Soil moisture, Moisture, Bibliographies, Reviews, Density, Radioisotopes, Ceramic materials, Radioactivity techniques, Cobalt radioisotopes, Soils, Soil moisture, Peat, Cements, Wood, Textiles, Fibers, Materials, Test procedures, Soil mechanics.
Identifiers: *Gamma probes, *Nuclear density meters, *Water content, Cesium radioisotopes.

Determining the amount of moisture in a given substance is a necessary part of many physical and chemical processes. Neutron moisture gages are used for this purpose, based upon the moderation of neutron by hydrogen. However, many substances have hydrogen as part of their chemical composition and neutron measurements would be in error for these materials. Gamma radiation may be used for an indirect determination of moisture content; gamma radiation is used to measure the densities of a dry sample and a moist sample, and moisture is determined with the assumption that the difference in densities is the result of the difference in water content. Applications of gamma radiation to determine the moisture content in soil, peat, wood, ceramics, construction materials, meat, and textile fibers are reviewed. The source isotopes were Cobalt 60 and Cesium 137 used at strengths of 1 mc to 10 curies of Cobalt 60, and 5 mc to 251 mc of Cesium 137. (USBR)
W70-04641

CORROSION RESISTANCE OF TITANIUM AND ITS ALLOYS IN PRIMARY WATER AND HOT BRINE ENVIRONMENTS,
Titanium Metals Corp. of America, West Caldwell, N.J.
N. G. Feige.
Preprint SM-113/25 of Paper Presented at IAEA Symp. Nucl. Desalination, Madrid, Spain, Nov. 18-22, 1968. 20 p, 7 fig, 16 ref.
Identifiers: *Corrosion tests, *Titanium, *Titanium alloys, Corrosion, Corrosion control, Corrosion problems, Crevice corrosion, Fabrication materials, Heat transfer, Pitting (Corrosion), Tubing (Metal).

A review of corrosion evaluation studies and subsequent alloy development program has resulted in a series of titanium base alloys suitable for service at temperatures up to 350 deg F. A critical area in a nuclear desalination plant is the interface between the primary water or steam in the nuclear system and the hot concentrated brine in the desalting plant. Titanium, because of its compatibility with both environments, has been considered in these heat exchangers to reduce the probability of tube failure. In the nuclear system under primary water conditions titanium appears to suffer no corrosion attack other than the buildup of an adherent oxide tarnish film. In the hot brine environment pitting corrosion or crevice corrosion at elevated temperatures limits a commercially pure alloy as heat exchanger tubing to service below 250 deg F. The laboratory experimental techniques developed during this program are reviewed. The information obtained from each test is related to the mechanism of corrosion attack, and the available alloy additions and their effect in modifying the rates of reaction are reviewed. Field service experience with titanium is reviewed and related to the laboratory test program.
W70-04667

ALLOY SELECTION FOR HEAT-EXCHANGER SERVICE IN SEAWATER-CONVERSION PLANTS,
Battelle Memorial Inst., Columbus, Ohio.
F. W. Fink.
Copper Develop. Assoc. Tech. Rept. 704/6, June, 1966. 38 p, 37 ref.
Identifiers: *Corrosion, *Fabrication materials, *Heat exchangers, Aluminum, Copper, Copper alloys, Stainless steels, Titanium.

Copper alloys have long been used for heat exchangers in applications involving seawater since they have a unique combination of properties which make them an excellent choice for this service. One of the oldest of these alloys, arsenical admiralty (copper alloy no. 443), still can be useful in the less severe, lower temperature stages of a multieffect distillation plant. Arsenical aluminum brass (copper alloy no. 687) has shown excellent performance in hot seawater applications and is widely used. However, for the higher temperature stages in some of newer plants the copper nickels are preferred. Many designers favor the iron-modified 90-10 copper nickel (copper alloy no. 706), since it is superior to the aluminum brass in performance, and is less costly than the iron-modified 70-30 copper nickel (copper alloy no. 715). The higher nickel content alloy is favored where the severe service conditions are beyond the range of presently available information. Quantitative long-term corrosion data for copper alloys are urgently needed. Present information comes from limited experience with pilot or demonstration plants or from spool-test-type specimens immersed in the seawater streams of such plants.
W70-04929

TITANIUM TUBES NOW FIGHT SEA WATER,
Harvey Aluminum, St. Croix, Virgin Islands.
M. H. Sims.
Power, Vol. 112, No 9, p 63-65, 1968. 5 fig.
Identifiers: *Corrosion, *Heater-evaporator tubes, *Operating experience, *Titanium, Corrosion control, Crevice corrosion, Erosion corrosion, Evaporators, Fabrication materials, Tubing (Metal).

After 2 years of continuous operation the titanium tubing in the multistage flash distillation plant at St. Croix, V.I., shows no sign of tube erosion or crevice corrosion. The plant was constructed by Westinghouse for Harvey Aluminum to produce 0.75 MGD at 185 deg F or 1.5 MGD at 250 deg F. The plant has 0.028-in.-thick tubes, 5.8-in.-dia in the evaporator and 1-in.-dia in the heat reject and heat recovery sections. The plant has been operating at 220-250 deg F with an output of 1 MGD. No scaling problems have been encountered - on-stream avid cleaning of the tubes was used when some tube fouling was indicated.
W70-04931

CORROSION OF MILD STEEL UNDER OPERATING CONDITIONS OF A DISTILLATION DESALTING PLANT.

Desalination Vol 5, p 90-94, 1968. 4 fig. Also Preprint from 2d European Symp.-Fresh Water From The Sea, Vol 4, Athens, May, 1967.
Identifiers: *Corrosion, *Fabrication materials, *Low alloy steels, Corrosion tests, Deaeration, Experimental data, Research results.

The influence of temperature, salinity, chloride, sulfate, and seawater velocity on the corrosion resistance of mild steel was investigated to determine the possibilities of its application to desalting plants. The maximum corrosion of mild steel in caspian seawater under static conditions is 0 to 15 MM/YR (at 90 deg C) and with flow at a velocity of 1 to 2 M/SEC is 1 to 25 MM/YR (at 70 deg C). The corrosion rate of mild steel decreases abruptly in oxygen-free seawater under static conditions and is not higher than 0 to 0.01 MM/YR at 90 deg C. If mild steel is in contact with copper-base alloys or stainless steel, corrosion increases greatly. Maximum corrosion of mild steel in contact with electropositive materials in moving seawater is 2 to 3 MM/YR at 70 deg C. On the basis of these results, mild steel is recommended as a construction material for distillation plants if the seawater is deaerated and there is no contact with electropositive materials.
W70-04949

8H. Rapid Excavation

LARGE AGGREGATE SHOTCRETE CHALLENGES STEEL RIBS AS A TUNNEL SUPPORT,
Bechtel Corp., San Francisco, Calif.
For primary bibliographic entry see Field 08F.
W70-04636

10. SCIENTIFIC AND TECHNICAL INFORMATION

RESOURCE CONSERVATION GLOSSARY,
D. E. Hutchinson, and A. D. Stoesz.
Journal of Soil and Water Conservation, Vol 25, No 1, p 1G-52G, January-February 1970. 52 p, 30 ref.

Descriptors: *Publications, *Documentation, *Soil conservation, *Water conservation, Geology, Hydrology, Biology, Forestry, Economics, Ecology, Agronomy, Conservation, Engineering, Recreation, Ranges, Soils, Watershed management.
Identifiers: *Glossaries.

A glossary of resource conservation includes terms used in studies of agronomy, biology, conservation, ecology, economics, engineering, forestry, geology, hydrology, ranges, recreation, soils, and watersheds. The glossary is intended to serve as a reference for professionals, students, and laymen. (Knapp-USGS)
W70-04559

VOLUME TWO-TECHNICAL DEVELOPMENT PLAN, NATIONAL DATA PROGRAM FOR THE MARINE ENVIRONMENT.
System Development Corp., Santa Monica, Calif.
For primary bibliographic entry see Field 7C.
W70-04600

SUPPLEMENT TO A PLAN FOR A COMPREHENSIVE WATER RESOURCES RESEARCH INFORMATION EXCHANGE SYSTEM,
Leeds, Hill and Jewett, Inc., San Francisco, Calif.
Harvey O. Banks, and Charles G. Wolfe.
Available from the Clearinghouse as PB-190 398, $3.00 in paper copy, $0.65 in microfiche. Supplement of Report prepared for Office of Water Resources Research, Department of Interior, 1970. 13 p, 21 ref. OWRR Contract No 14-01-0001-1618.

Descriptors: *Publications, *Reviews, Water law, Social aspects, Planning, Surveys, Documentation, Editing, Technical societies, Water resources development.
Identifiers: *Water resources information, Information exchange.

The use and availability of water resources information to professionals in law, planning, and sociology is surveyed. Several of the most widely circulated periodicals in each of the disciplines under consideration were examined for the years 1965-1969 to ascertain what the readers of these publications could have learned from them concerning water resources problems. None of the publications examined has devoted a great deal of attention to water resources. If increased attention to water resources is to be stimulated beyond what may occur in any event, there must be an understanding of the audience to be reached and of the purposes that publications for the nonspecialist may be expected to serve. A significant part of the responsibility for disseminating technical information to experts in other disciplines should be assumed by persons other than those who initially do the research and write the monographs setting forth their findings. (Knapp-USGS)
W70-04693

AN ANNOTATED CLIMATOLOGICAL BIBLIOGRAPHY OF INDIA,
Environmental Technical Applications Center (Air Force), Washington, D.C.
For primary bibliographic entry see Field 02B.
W70-04981

HEAT TRANSFER-A REVIEW OF CURRENT LITERATURE,
Minnesota Univ., Minneapolis. Heat Transfer Lab.
For primary bibliographic entry see Field 08B.
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A NOTE ON THE THERMAL STRUCTURE OF THE EASTERN BERING SEA,
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ANALYSIS OF WATERSHED CHANGES,
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HYDROSCIENCE, INC., LEONIA, N.J.
INDUSTRIAL WASTE TREATMENT IN AERATED LAGOONS,
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ILLINOIS STATE WATER SURVEY, PEORIA. WATER QUALITY SECTION.
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MINISTRY OF TECHNOLOGY, LONDON (ENGLAND). LAB. OF THE GOVERNMENT CHEMIST.
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